



Vilnius University Proceedings



# 23rd Paleopathology Association European Meeting

August 25-29, 2022

Vilnius, Lithuania

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**ABSTRACT BOOK**



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WELCOME

## Dear colleagues,

We are excited to have you here, at the 23<sup>rd</sup> European Meeting of the Paleopathology Association. After a postponement of two years due to the *Coronavirus* pandemic, this will finally take place in Vilnius, capital of Lithuania. Although the conference will be in the form of a hybrid event, in order to allow the possibility of both physical and online participation, we are particularly grateful for the warm response of many of you from different countries and even continents, to gather here and update each other on research, promote cooperation, discuss new promising techniques, and finally revive and establish new contacts. While the central theme of the conference will be “Paleopathology and its impact on medicine and society”, focusing on the importance of both scientific achievements and public outreach, we were overwhelmed by fascinating topics expressed by a total of 147 contributions! These cover bone and soft tissue conditions, parasites and pathogens, as well as diet, disability, care, and ethics. As the world faces new different challenges that include climate change and even war-related issues, Paleopathology must necessarily confront with the present and contribute to create a more responsible planet, making sure the dead continue to be silent teachers for the living. Thank you for making this come true!

On behalf of the organizing committee,

**Professor Rimantas Jankauskas**

Chair

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### Venue

Radisson Blu Hotel Lietuva  
Konstitucijos av. 20, Vilnius

## Sponsors and Partners



Baltic-American Freedom Foundation



Bibliographic information is available on the Lithuanian  
Integral Library Information System (LIBIS) portal [ibiblioteka.lt](http://ibiblioteka.lt)

ISBN 978-609-07-0757-9 (print book)

ISBN 978-609-07-0758-6 (digital PDF)

<https://doi.org/10.15388/23rdPalAssocEuropMeeting.2022>

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# INVITED SPEAKERS

## **TOPIC: THE EVOLUTION OF PALEOPATHOLOGY: THE IMPORTANCE OF FOCUSING ON THE “HERE AND NOW” OF HEALTH AND WELL-BEING**



*Professor Charlotte Roberts,  
Durham University, England*

I am a bioarchaeologist and have studied and interpreted human remains from archaeological sites for the past 35 years. I also have a first career in nursing, and was elected as a Fellow to the British Academy in 2014. I am specifically interested in exploring the interaction of people with their environments in the past through paleopathology, and especially those health problems that are common today. My key research interests lie in: contextual approaches to past human health; contemporary health; evolutionary approaches to the origin and history of infectious diseases; big data projects in paleopathology; and ethics related to human remains. I am also very passionate about engaging audiences with my research beyond academia. I try to utilize multiple lines of evidence for reconstructing past health, including exploring the application of medical anthropological and evolutionary biological approaches to bioarchaeology. My nursing background, particularly, has guided me into taking an holistic approach to past ill health in bioarchaeology, something that was also considered essential in a hospital environment. Understanding why and how people and communities today experience health problems is essential to be able to understand ill health in the past. My key book publications include: *The backbone of Europe* (with R. Steckel, C. Larsen and J. Baten), *Human remains in archaeology* (2nd ed. 2018), *The global history of paleopathology* (2012, with J. Buikstra), *The archaeology of disease* (3rd ed. 2005, with K. Manchester), *Health and disease in Britain* (2003, with M. Cox), *The bioarchaeology of tuberculosis* (with J. Buikstra), and *The past and present of leprosy* (2002, with M. Lewis and K. Manchester), and I have published many journal papers and book chapters. I am a co-editor of a new forthcoming book *Palaeopathology and Evolutionary Medicine. An Integrated Approach*, to be published in April 2022 by Oxford University Press.

## TOPIC: PALEOPATHOLOGY AND ITS ROLE IN THE IDENTIFICATION PROCESS



*Professor Eugenia Cunha,  
University of Coimbra, Portugal*

Professor Cunha is a leading authority in the field of forensic anthropology. Since 2018, she is the director of the South Delegation of the National Institute of Legal Medicine and Forensic Sciences (NILMFS), Lisbon, Portugal, and member of the direction of the Institute. Full professor at the University of Coimbra since 2003, she created and coordinates the Laboratory of Forensic Anthropology and is a researcher at the Centre for Functional Ecology. Cunha serves as a national consultant in Forensic Anthropology for the NILMFS in Portugal since 1997 and as a forensic anthropologist of the South Delegation of the NILMFS since 2004. In addition, she is a C-FASE- Honoris Causa certified practitioner in Forensic Anthropology by the FASE/IALM, International Academy of Legal Medicine, since 2014. She was also invited lecturer at the Université Paul Sabatier III, AMES, France (2016), at the Faculty of Medicine, University of São Paulo, Ribeirão Preto, Brazil (2017), and at Stanford University (2020, Tinker visiting professor). A teacher of the postgraduate course on Forensic Anthropology and Human Rights, UNIFESP, São Paulo, Brazil, since 2017 and of the Master and PhD courses in Physical and Forensic Anthropology of the University of Granada, Spain, she was also co-founder and President of the FASE-Forensic Anthropology Society of Europe (2009-2015), Fellow of the American Academy of Forensic Sciences, and Founder member and vice-president of the ABRAF-Brazilian Association of Forensic Anthropology (2014).

## TOPIC: TIME-TRAVELING WITH ANCIENT DNA



*Professor Hendrik Poinar,  
McMaster University, Canada*

Hendrik Poinar is an evolutionary geneticist who develops and employs novel enrichment and sequencing strategies to access ancient genomes from fossil remains, in order to reconstruct their evolutionary history. He completed his PhD at the University of Munich, was an EMBO fellow at Cancer Research UK, a postdoctoral fellow at the University of Oregon and a Junior Group leader at the Max Planck Institute for Evolutionary Anthropology in Leipzig, before becoming a Canada Research Chair in Paleogenetics at McMaster University in 2003. The son of noted entomologist George Poinar, Jr and Eva Hecht-

Poinar, Poinar received his BS and MS degrees from California Polytechnic University, San Luis Obispo in 1992 and 1999 respectively before earning a PhD in 1999 from the Ludwig Maximilians University of Munich, after which he was a postdoctoral researcher from 2000 to 2003 at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. As an Associate Professor and Canada Research Chair at McMaster University, he uses both chemical and molecular techniques to elucidate the state of preservation within forensic, archaeological and paleontological remains. This information is subsequently used to devise novel techniques to extract the molecular information (DNA and/or protein sequences) which is then used to address evolutionary and anthropological questions, such as the “relatedness” of Archaic humans and Neanderthals from a genetic standpoint, sex and diet from prehistoric Native Amerindian hunter-gatherer populations using coprolites samples, and the timing and origin of HIV using archival blood and brain tissue samples.



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# ABSTRACTS

## PRESENCE OF TREPONEMATOSIS IN THE TEMPLAR DISTRICT OF PARIS (XII–XIV/XV–XVII CENTURIES)

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In 2011, in the center of Paris, about 4,000 m<sup>2</sup> have been unearthed, due to the rehabilitation of the “Carreau du Temple” market (actual third district) within the Templar enclosure. As a follow-up, a Templar district founded during the second half of the 12th century had been excavated. The western part of the site evidenced remains of the Sainte-Marie-du-Temple church and its adjoining cemetery. Funerary occupation showed two different periods of inhumation, one referring to the Templar population between the 13th-14th centuries (phase 1) and another one related to the parish of the Templar ring, in use during the 15th-17th centuries (phase 2). The paleopathological study of the corpus specimens evidenced cranial and tibial lesions potentially linked to treponemal diseases. Finally, our results consider one adult male subject from the medieval phase and two crania for the modern one. Additional paleomicrobiological analyses were carried out with dental samples. Preliminary results yielded optimistic results for *Treponema pallidum* ssp., thus confirming the macroscopic suspicions of treponemal disease involvement in this sample.

**Keywords:** Paleomicrobiology, paleopathology, human remains, Paris

## SURVIVING TRAUMA IN MEDIEVAL SUDAN

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An older adult female with extensive skeletal trauma was buried in a prominent location within a large late Meroitic to Christian period cemetery (ca. AD 250-1400) in the Bioarchaeology of Nubia Expedition (BONE) project area in northern Sudan. Dating to ca. 1100 CE, her rock-covered grave was amidst a cluster of older, large Post-Meroitic tumuli. A healed depression fracture is located on the left parietal. Probable sharp-force trauma across the right scapula also affected the vertebral ends of ribs 2-6. Healed fractures are present near the midshaft of right ribs 7-8 and rib 12, the latter likely related to a compression fracture of the first lumbar vertebra and healed fracture of the right ischiopubic ramus. A fracture of the left femoral neck healed with anteroinferior displacement and myositis ossificans traumatica, yet the head remained articulated in the acetabulum. The mandible was dislocated, with attenuated condyles, severe dental caries, abscesses, antemortem tooth loss, and avulsion of the left central incisor. Removal of the incisor may have assisted feeding through a straw. While mobility was impaired due to femoral neck angulation and shortening of the left femur, the severe osteoarthritis in both shoulder joints suggests use of crutches. This individual clearly required care to survive substantial trauma and live into old age. Her grave placement and some traditional features suggest she held a special status in her community, perhaps reflecting survival and remembrance of a past conflict during a period of strife in this region.

**Keywords:** Interpersonal violence, trauma, impairment, care, funerary treatment

# AN INVESTIGATION OF LINEAR ENAMEL HYPOPLASIA AND PHYSIOLOGICAL STRESS THROUGH HISTOLOGICAL AXIAL CROSS-SECTION AND INCREMENTAL DENTINE ANALYSIS

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Linear Enamel hypoplasia (LEH) appears as abnormal enamel deposition on teeth and is related to physiological, metabolic and environmental factors during infancy and childhood. The exact etiology of the condition, however, is still unknown. LEH can be examined macroscopically, but microscopical examination of tooth cross-sections, enables more accurate observation and estimation of the timing and occurrence of stress. Similarly, the examination of subannual shifts of carbon and nitrogen isotopic ratios in dentine increments offers the possibility to identify periods of physiological stress during early life, as a result of a maladaptive weaning process or other factors. Our study aims to examine if physiological stress evidenced from carbon and nitrogen isotopic values coincides chronologically with the formation of hypoplastic defects, exploring a possible relationship between the two conditions. For this purpose, we reconstructed the weaning patterns of 65 individuals, analyzing collagen from 720 increments of first permanent molars. The skeletal material originates from the city of Thessaloniki and dates from 315 BCE to the 7th century AD. Our analysis showed that 20 individuals have isotopic ratios associated with physiological stress, while macroscopic analysis of their dentition revealed defects of enamel hypoplasia. The histological axial cross-section analysis on permanent canines and incisors showed that hypoplastic defects occurred during the weaning process for these individuals. Our goal is to explore whether maladaptive breastfeeding and weaning patterns are associated with permanent defects on the skeletal record.

**Keywords:** Carbon and nitrogen isotope analysis, breastfeeding, weaning, ancient Greece

**Funding agencies:** This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH – CREATE – INNOVATE (project title: ECHOES-Development of a methodology for the digital reconstruction of ancient human biographies through the study of archaeo-anthropological material, project code: T2EDK-00152).

# A REVIEW OF CHAGAS DISEASE AND *TRYPANOSOMA CRUZI* EVOLUTION IN SOUTH AMERICA: THE STOCKHOLM PARADIGM

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Parasites, as other pathogens, are resource specialists with restricted geographic range, and yet, shifts to novel hosts are common in their evolutionary diversification. The scenario in which parasites can have highly specialized relationships with their hosts and yet switch to a new one is known as host-switching. The pathogen's capacity to host-switching has been explained by the Stockholm Paradigm. This is a model of evolution of parasite systems that links ecological perturbations caused by climate oscillations with parasite diversification and the rise of novel host-parasite associations. Instances of host-switching in the past have been reported in the literature; a good example is the case of Chagas disease. Chagas disease (also known as American trypanosomiasis), caused by the protozoan *Trypanosoma cruzi*, is a vector-borne disease transmitted by triatomine insects, a family of mostly nocturnal blood-sucking reduviid bugs that feed on mammals, reptiles, and birds. Archaeoparasitology has revealed a complex evolution and association of trypanosomes with humans and vectors, involving sylvatic and domiciliation cycles, that expands nine millennia. This presentation will review the results of decades of study considering the environmental and climatic disturbances as well as the human factors that acted as catalysts to the emergence and domiciliation of *Trypanosoma cruzi* infections. Today, Chagas disease is endemic in 21 Latin American countries, affects 6-7 million people with another 75 million at risk, and is a leading Neglected Tropical Disease. The history of Chagas disease serves as a past model to understand the current Emerging Infectious Disease crisis.

**Keywords:** Chagas disease, *Trypanosoma cruzi*, Stockholm Paradigm, climate change

# INVESTIGATING PUBERTY IN PRE-ROMAN TIMES: FIRST OSTEOLOGICAL ASSESSMENT OF PUBERTAL DEVELOPMENT IN ETRUSCAN-SAMNITE ADOLESCENTS (PONTECAGNANO, SOUTHERN ITALY)

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The present study offers the first investigation of the biological transition from childhood to adulthood in pre-Roman Italy. Thanks to the recent development of innovative method for assessing stages of pubertal growth in osteoarchaeological remains, puberty is emerging as a new compelling indicator of adolescent life conditions and health status in past societies. With the purpose of contributing to the exploration of this crucial phase of life course, stages of pubertal development were assessed in 84 adolescents dated back to the Etruscan and Samnite periods of Pontecagnano, southern Italy (7<sup>th</sup>-4<sup>th</sup> centuries BC). The average ages of onset and completion of puberty were detected, in addition to the achievement of relevant milestones such as menarche and sexual maturation, representing not only significant physical transitions, but also crucial passages in the social identity of individuals. In Pontecagnano, distinctive peculiarities in the timings and the duration of puberty were identified, such as an important interindividual variability and a stretched pubertal tempo. We argue that these specific trends derived from the biocultural interactions of this population with the unicity of Pontecagnano environment, that includes the presence of endemic diseases characteristic of marshy landscape, such as malaria and thalassemia, and endocrine-disrupting pollutants produced by the Etruscan and Samnite metallurgical industries. The reconstruction of past pubertal patterns can thus offer unprecedented direct insights into past life courses and adolescent growth, providing unique perspectives on medical debates about contemporary variations in pubertal trends, and challenging common assumptions about what is “normal” and “pathological” in pubertal development.

**Keywords:** Pubertal development, Mediterranean, menarche, adolescence, skeletal maturity

# MIDDLE MENINGEAL ARTERY ANEURYSM: A POSSIBLE CASE IN A CHILD FROM THE ETRUSCAN SITE OF PONTECAGNANO

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A middle meningeal artery (MMA) aneurysm is a variety of intracranial aneurysm that is not completely understood in clinical medicine and has been rarely documented especially in pediatrics, since juvenile cases are particularly infrequent. Vascular disorders have occasionally been identified in osteoarchaeological remains, confirming their occurrence in past times. The present report illustrates a lesion that is highly consistent with a case of an MMA aneurysm detected in a child, brought to light during the archaeological excavations in the Etruscan site of Pontecagnano (Salerno, southern Italy) and dated back to the 7<sup>th</sup> to 6<sup>th</sup> century BC. Macroscopic examination and radiological analysis revealed an oval depression in the endocranial region corresponding to the parietal branch of the right MMA. The absence of a bone reaction and the localized thinning of the bone were consistent with a long-lasting compression of vascular origin compatible with an MMA aneurysm. The differential diagnosis rejected benign neoplastic conditions, primary malignant bone tumors, bone metastasis among other non-neoplastic conditions, such as eosinophilic granuloma, sarcoidosis, and calvarial venous malformations, despite the occurrence of other disorders, including dural arteriovenous fistulas, could not be ruled out. It could not be excluded that extradural hemorrhage and/or intracranial hemorrhage subsequent rupture could have caused the death of the child, though it was not possible to confirm whether the MMA aneurysm was symptomatic. From a paleopathological standpoint, the case described offers a compelling historical perspective on an uncommon neurovascular disease that continues to be discussed in modern clinical research.

**Keywords:** Pediatric intracranial aneurysm, pre-Roman groups, skull lesion, Southern Italy, vascular pathology

# EVIDENCE OF PLAGIOCEPHALY FROM TWO MEDIEVAL ITALIAN TOMBS

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Plagiocephaly, from the Greek 'oblique head', is defined as an abnormal asymmetrical and flattened shape of the cranium occurring in infancy, characterised by a synostotic or deformational etiology. Deformational plagiocephaly, or positional plagiocephaly, is caused by asymmetrical external forces due to prolonged partial support of the posterior portion of the head when the child lies supine. Here we present, as a case study, a high concentration of skulls affected by positional plagiocephaly (9/15, 60%), found in two medieval collective tombs, excavated in Italy in 2015, near the small church of San Pietro di Salzan (Santa Giustina municipality, Belluno, Veneto). The two tombs represent different funerary contexts: one tomb is an ossuary containing the remains of twenty individuals (14 adults; 6 sub-adults) and a female skeleton still in anatomical connection. Thirteen skulls were recognized, among them two with severe and four with moderate plagiocephaly. The second tomb is a multi-phase burial, with a sequence of five overlying primary burials (all adults) and the remains scattered in the fills of another eight individuals (5 adults, 3 sub-adults). Only five skulls were found, one with severe and two with moderate plagiocephaly. Thanks to the relative stratigraphic sequence of six phases in the second tomb, with plagiocephaly detected in the first and the last, it is possible to recognize a common and possibly enduring behavioral aspect. This paleopathological study helps to observe pediatric behavior in the past, a kind of cultural exaptation of what is recommended even today by modern pediatricians.

**Keywords:** Paleopathology, plagiocephaly, Middle Ages, Veneto, Italy

# RECONSTRUCTING CARE TREATMENT IN LONGOBARD ITALY: AN ATTEMPT VIA A MULTI-PROXY INVESTIGATION

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A case of trepanation has been documented on a cranium from the Longobard cemetery of Castel Trosino (central Italy, 6th–8th centuries CE). The cranium represents the only remains of an elderly woman (ca. 50yo), and the medical treatment, or the condition that led to it, likely influenced her life course. In this study we have attempted to reconstruct her life-history via multi stable isotope analysis on different tissues. This will assist in reconstructing variations in the nutritional intake and has the potential to highlight physiological stresses during specific time intervals. The isotopic values of the latter years of her life are consistent with those of other adults from the cemetery (n=18). Her life conditions and the level of healthcare will be presented via paleopathological and isotopic analyses, supported by the archaeological context and the medical literature. Our analysis suggests that the community members cared for this woman, at least by providing her with a consistent food intake. This sheds light on two possible, non-mutually alternative, scenarios: a) she had a privileged social status that favored such treatments; b) the care for individuals with severe ailments was likely a practice included in the community habits.

**Keywords:** Trepanation, bioarchaeology, Early Middle Ages

# THE PLAGUE ENIGMA: CLIMATE CHANGE AND HEALTH RISKS IN MADAGASCAR

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The control of zoonoses is a key factor within the “One Health” approach; the microbes affecting animals also affect also humans as they share the same ecosystem and all are conditioned by climate change. Research, policies and legislations have been established to ameliorate the environmental, animal and human conditions towards an effort to reach an equilibrium in sustainability. One of the areas of interest is Madagascar. Climate change is deeply impacting the health of the Malagasy population and is acting on the reservoir-vector-human chain of transmission of several diseases, including plague. Plague has active endemic foci in the Central Highlands which were/are stably maintained by wild rodent reservoirs. Plague outbreaks occur every year in Madagascar between September and March; given the high number of reservoirs and vectors, plague eradication from Madagascar is deemed impossible. It appears that nowadays plague can occur in any new location at any time in the island; climate changes, land degradation, and anthropogenic factors are having a major impact on its incidence. Recently, a large outbreak of pneumonic plague (September 2017) reached the capital Antananarivo and the seaport of Toamasina and called the world’s attention. This communication highlights how an ancient scourge, responsible for two major historic pandemics and a modern one, is still a global threat. The main public health and surveillance measures adopted to control and prevent the spread of the infection are presented and discussed.

**Keywords:** Madagascar, third plague pandemic, active plague foci, climate change, health risks

# PALEOPATHOLOGY-INFORMED SAMPLING STRATEGIES FOR *MYCOBACTERIUM TUBERCULOSIS* COMPLEX ADNA RECOVERY AT TLATELOLCO, A MESOAMERICAN URBAN CENTER (1300-1521 CE)

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Tuberculosis (TB) is a global disease that remains a significant cause of morbidity and mortality, despite decades of vaccine development efforts, concerted public health campaigns, and improvements in detection and treatment. To understand the evolutionary success of the causative agents of TB, members of the *Mycobacterium tuberculosis* complex (MTBC) can be analyzed directly using ancient genomes recovered from archaeological remains. Our ability to predict successful MTBC aDNA recovery, however, remains tenuous, resulting in destructive sampling that yields few successful results. To address the ambiguous relationship between sampling strategy and MTBC aDNA yield, we selected 56 elements representing 48 individuals with a spectrum of skeletal lesions associated with TB from Tlatelolco, a late postclassic Mesoamerican urban center (1300-1521 CE). We subsampled and extracted DNA from each element in various locations and across various pathological categories. DNA extracts were shotgun sequenced, and MTBC positive samples were identified using a taxonomic binning approach with a custom database of mycobacteria and other closely related genera. Of 56 elements, 13 representing six single burials and four ossuary deposits were positive for MTBC DNA. Positive screening assignments were confirmed using whole genome in-solution hybridization capture. We compared differences in overall skeletal pathology, sampling element, sampling location, and pathological category between MTBC positive and negative samples and within MTBC positive samples. Our findings suggest that sampling element, pathological manifestation, and age of individual affect MTBC DNA recovery. Here, we discuss the implications of these results for MTBC aDNA sampling

and propose guidelines for justifying destructive sampling projects.

**Keywords:** aDNA, tuberculosis, sampling strategy, Mesoamerica

**Funding agencies:** This research was funded by the National Science Foundation (BCS-1515163 to ACS and JEB and BCS-1945812 to KEB and ACS) and a Fulbright-García Robles Fellowship to KEB.

# WHAT CAN SKELETAL DEFORMITY TELL US ABOUT SOCIAL BEHAVIOR? KLIPPEL-FEIL SYNDROME IN A NABATAEAN NOBLEMAN FROM THE ISRAELI DESERT

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‘Bioarchaeology of care’ enables us to learn about the attitude of past societies toward the sick and disabled from bones. Nevertheless, skeletal remains allowing us to carry out such a study are rare. Here, we present a possible case of Klippel-Feil syndrome (KFS), a rare congenital disease, in an almost complete adult male (H-1; ca. 40-50 years old) from the Arava desert (Israel) dated to the Nabataean period (2<sup>nd</sup> century BCE). H-1 was recovered from a remarkable double-chambered mausoleum built on a hilltop. Following a thorough examination of the skeletal remains (including  $\mu$ CT scans), we identified several pathologies: a cervical block (C2-C4), Sprengel’s deformity (SD), extensive antemortem tooth loss, and two poorly healed fractures in the distal left forearm. The characteristics of the vertebral fusion suggested a different etiology for each of the levels: congenital fusion between C2 and C3 and ankylosis with degenerative changes between C3 and C4. Cervical fusions, along with SD, are typical of KFS. The badly healed fractures identified in the left radius may suggest H-1 suffered from recurrent falling due to instability. These manifestations resulted in a deformed external appearance and likely some level of disability. Consequently, considering his age, H-1 was probably regularly supported by his community. Moreover, his exceptional burial indicates that he was a nobleman. Therefore, we assume that his disability did not affect his social status. This assumption concurs with what has been learned from ancient written sources and archaeological remains about the social order and solidarity of the Nabataeans.

**Keywords:** Klippel-Feil syndrome, cervical fusion, Nabataeans

# IS THERE EVIDENCE FOR JOINT HYPERMOBILITY IN THE HUMAN SKELETON? REVIEW OF THE LITERATURE AND DIRECTIONS FOR THE FUTURE

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A significant challenge that bioarchaeologists face is the difficulty of identifying disability in the archaeological record, specifically conditions that primarily affect the soft tissues. One such condition is ‘joint hypermobility’, a term used to describe joints with an atypical extended range of motion. Joint hypermobility is associated with conditions affecting the collagen and connective tissues of the body (i.e. Ehlers-Danlos Syndrome) and with symptoms such as joint instability, disturbed proprioception, and frequent dislocations. While woefully understudied in modern populations, joint hypermobility is minimally researched by archaeologists. Some archaeological studies and research articles refer briefly to joint hypermobility, however, none offer any guide to the identification of joint hypermobility in human skeletal remains. To address the lack of consensus and practical advice for identifying joint hypermobility in the skeleton, a review of the current literature on joint hypermobility and bone changes was performed using 46 selected studies. To be included in the review, studies had to be peer reviewed, make use of the Beighton test or other validated criteria for determining joint hypermobility, and use logical quantitative methods. Despite problems with the methodologies of some selected studies and limited research in the area, this review revealed promising evidence for signs of hypermobility in the skeleton. Such evidence may include: premature osteoarthritis, osteoarthritis in unusual locations, increased prevalence of injury, and temporomandibular joint disorders. The findings of this paper are preliminary but promising and suggest that more research into this area may yield useful conclusions for archaeology and anthropology.

**Keywords:** Joint hypermobility, bioarchaeology, osteoarthritis, collagen, disability

# A TREPONEMAL GENOME FROM AN HISTORIC PLAGUE VICTIM SUPPORTS A RECENT EMERGENCE OF YAWS AND ITS PRESENCE IN 15<sup>TH</sup> CENTURY EUROPE

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Advancements in methods for pathogen DNA detection in archaeological samples can enhance our understanding of disease spread in time and space. Here we report on the application of a hypothesis-free method for molecular pathogen screening in 26 putative historical plague victims from post-medieval Vilnius, Lithuania. This process revealed the presence of more than one active disease in one individual: In addition to *Yersinia pestis* we detected and genomically characterized a septic infection of *Treponema pallidum pertenuae*, a subtype of the treponemal disease family recognized as the cause of the tropical disease yaws. Our finding of yaws in northern Europe was unexpected given modern epidemiology of the disease, where it is reported in equatorial regions only. Further to this, a molecular dating analysis revealed a most recent common ancestor for all circulating yaws strains in the last millennium, indicating that the disease cluster is much younger than previously thought. Its recent emergence and presence in northern Europe during this time period are interpreted within an historical framework of intercontinental trade and potential disease movements. Through this we offer an alternative hypothesis for the history and evolution of the treponemal diseases, and posit that yaws be considered a contributor to the widespread physically disfiguring disease that appeared suddenly in late 15<sup>th</sup> century Europe.

**Keywords:** Ancient DNA, yaws, plague, epidemic

# THE USE OF DECISION TREE ANALYSIS FOR DIAGNOSIS OF TUBERCULOSIS IN THE SKELETON

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Pathological bone lesions are often difficult to diagnose and interpret. By making use of statistical methods based on data mining and machine learning, the possibility exists to explore patterns in the occurrence of lesions to distinguish between different conditions or diseases. The aim of the study was to test the applicability of decision tree analysis in paleopathology. A sample of 436 skeletons was selected from the Raymond A. Dart Collection of Human Skeletons that comprised of 177 individuals known to have died from tuberculosis, 109 skeletons listed with pulmonary disease and 150 individuals as a control group. The presence (1) or absence (0) of skeletal lesions were scored for 23 variables related to tuberculosis and/or pulmonary disease. Decision tree analysis was performed using the WEKA data mining software. The J48 pruned tree function was employed. The statistical output indicated hidden patterns in the data suggesting that skeletal areas often associated with tuberculosis such as the acetabulum may be highly indicative of pulmonary disease. Furthermore, the confusion matrix showed that a large number of the control group and individuals with pulmonary disease were classified as having tuberculosis. The results thus indicate that the overlap of occurrence of skeletal lesions between the groups is large, and that diagnosing tuberculosis based on generalized skeletal lesions may be inaccurate. Further investigation should be done using a larger sample size to clarify the association between tuberculosis, pulmonary disease and the relevant skeletal involvement.

**Keywords:** Tuberculosis, pulmonary disease, decision trees, classification

# EXPOSING OURSELVES: DEALING WITH ETHICS TOWARDS THE DISPLAY OF HUMAN REMAINS

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Over recent years working with human remains has raised numerous ethical issues, which brought about re-evaluation of practices, while enabling their ongoing use in research and exhibition projects. In 2020-2022, the temporary exhibition 'Experts at Aventicum', has launched at the Musée romain d'Avenches (Switzerland), inspired by the human skeletal collections recovered at the site and following their study during a three-year research project. Such an exhibition, relying almost –if not entirely– on the display of human skeletal remains differed greatly from past temporary exhibitions at the museum, as it marked a significant shift on the expectations of the visitors towards the co-creation of knowledge. This presentation will focus on the display of human remains in archaeological museums, tackling issues such as how scientific knowledge discovers its dissemination paths to the wider public, without sensationalizing, but balancing between ethical considerations and current interdisciplinary methods. It will also offer an overview of the lessons learned throughout the preparation of the exhibition, highlighting both achievements and challenges encountered along the way.

**Keywords:** Human skeletal remains, ethics, display

# THE 'MAGIC NUMBER' AND APPROACHES TO DIAGNOSIS IN PALEOPATHOLOGY

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Paleopathological diagnosis plays a crucial role in reconstructing health and life histories in past communities, providing a long-term perspective on current and future disease patterns. Paleopathologists have made advances in diagnosing many conditions, and there have also been recent valuable discussions of the theoretical and practical approaches and frameworks used. Still, there has been a recent trend towards taking the number of lesions present as a key factor in deciding if a diagnosis can be suggested. This paper aims to show that there is no magic number of lesions to suggest a diagnosis. Using the closely linked group of conditions, rickets, scurvy and anemia, with examples drawn from my work and other publications, I will review recent developments in the understanding of lesions in the context of frameworks and theories used to suggest a diagnosis. I will make the case that there is no magic number of lesions required to diagnose many diseases, particularly the metabolic conditions. The expression of lesions is dependent on numerous factors, including biological variables such as the age of onset and age-at-death. Environmental and sociocultural factors also contribute to any condition's development, duration, and severity, with consequences for lesion expression. Integrative approaches that combine information on the individual, their context and underlying biological processes present in any disease will enable greater confidence in suggested diagnoses.

**Keywords:** Rickets, scurvy, anemia, skeletal lesion, theory

# THE STOCKHOLM PARADIGM AND THE DAMA PROTOCOL: USING THE PAST TO HELP COPE WITH THE EMERGING INFECTIOUS DISEASE CRISIS

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The Stockholm Paradigm (SP) explains evolutionary survival, persistence, and diversification leading to complex ecosystems described by Darwin's "entangled bank" metaphor. The SP predicts that emerging infectious disease (EID) occur when environmental perturbations create ecological opportunities for susceptible, but previously unexposed, hosts to encounter pathogens. Highly specialized pathogens expand their host range based on pre-existing genetic capacities. Environmental stability allows them to specialize with new hosts, leading to novel variants and new pathogen species. This sets the stage for the new EID when new environmental perturbations occur. Pre-Holocene humans migrated from climate change events, perhaps triggered by EID in some cases. Such movements left some pathogens behind, carried some with migrating humans, and allowed contact with new pathogens. Holocene sedentism and high production agriculture and domestication, and later global trade and travel, and warfare with forced migration, increased EID opportunities. The DAMA (document, assess, monitor, act) Protocol policy extension of the SP aims to prevent EID. Specialized transmission modes and microhabitat preferences are phylogenetically conservative, so we can reasonably predict what diseases our ancestors left behind, carried with them, and encountered when changing geographic locations, habitats and diets. Integrating the lessons of the past can help cope with the present crisis.

**Keywords:** Stockholm Paradigm, disease, climate, change

# ONE PALEOPATHOLOGY: INTERDISCIPLINARITY IN ADDRESSING GLOBAL QUESTIONS

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This presentation introduces ONE Paleopathology, a wholistic paleopathology that develops from the biomedical ONE Medicine/ONE Health initiatives. ONE Paleopathology, like its biomedical analogues, extends a core veterinary science/animal paleopathology to the creation of encompassing and evolving global health perspectives. Engaging all aspects of health, including animals and their environments, ONE Paleopathology facilitates addressing worldwide issues of significance, past and present. We initially review the histories of ONE Medicine, ONE Health, and Paleopathology as these topics anchor ONE Paleopathology. We then illustrate how, by using a ONE Paleopathology approach, biomedical advances in imaging and genomics mesh naturally with traditional observations of contexts and morphological observations of remains. Such methodologically sophisticated developments encourage investigations of disease, past or present, to extend beyond morphological assessments. However, to take full advantage of the remarkable new opportunities, an integrated, problem-oriented approach is required. The identification of significant questions should receive primary emphasis, rather than techniques. As illustrated by its application to *Burkholderia* spp., morbilliviruses, *Mycobacterium* spp., and metabolic bone diseases, a ONE Paleopathology approach uses an evolutionary context to integrate the perspectives provided by multidisciplinary knowledge bases. It thus provides the global and technologically sophisticated viewpoint required to truly understand the complex histories of diseases and can inform both future research and clinical applications.

**Keywords:** Paleopathology, ONE Health, glanders, melioidosis

# ALL THE GROWTH IN BONE IS NOT ALWAYS PATHOLOGICAL: DIFFERENTIATING BETWEEN ONTOGENIC AND PATHOLOGICAL SUBPERIOSTEAL NEW BONE AND EXTRACORTICAL POROSITY IN NON-ADULT SKELETONS

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Differentiating pathological subperiosteal new bone (SNB) and extracortical porosity (EP) from the natural growth in non-adult skeletons have been extensively debated in paleopathology. This research attempts to clarify the controversy when comparing ontogenic and pathological extracortical topographies in identified skeletonized individuals. The 172 individuals with ages at death (5 gestational months to 6 years-of-age, mean: 9,4 postnatal months) and causes of death recorded in the Granada identified skeletal collection were observed. All bones except vertebrae, ischium, pubis, fibula, hands, and feet were subjected to an extracortical preservation assessment and a macro, stereoscopic, and scanning electron microscopic topographic evaluation. Three features were prioritized: porous extension per surface; pore contour morphology; and fibrous vs. lamellar appearance. The excellent preservation of the osteological collection (94,96%) helped in the macro/microscopic skeletal evaluation. If the disease is active at the time of death, when analyzing any bone, an inflammatory reaction will initiate, producing: 1) increasing SNB reactivity reflected both in the greater inclination of the growing bone walls, which end in irregular contours, and in the cessation of the centrifugal guidance of the new bone; 2) greater EP density and diameter. Although growth variability acts as a tangled factor, such differences are more easily identified in older individuals with lamellar cortices (>4 years-of-age). These results will allow to distinguish between normal growth and SNB and EP of pathological origin and alerts to the age-related interindividual variability in growth rates. These results should be confirmed in other osteological series including by histological analysis.

**Keywords:** Fetuses, infants, extracortical bone layer, woven bone, microscopy, inflammation

# DROUGHT, DIET AND PARASITISM IN NEW MEXICO: IMPLICATIONS FOR POROTIC HYPEROSTOSIS

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We analyzed 110 coprolites from the drought period for the Puebloan sites of Aztec and Salmon Ruins. Both sites can be placed in the Ancestral Pueblo III occupation (AD 1180-1260). These sites are typical of large, defensible towns that survived this time of threat by virtue of large populations in stonewalled villages with accessible water. We hypothesize that the concentration of large numbers of people promoted pinworm infection and, therefore, explains the phenomenal levels of infection at these sites, 33-72.7%. Dietary analysis of the same samples shows a diminished use of maize (54%) and beans (24%) compared to other Puebloan sites. This was a diet low in vitamin B12 and folic acid. Recent clinical analyses show that high pinworm infections leach B12 and folic acid. Therefore, it is likely that the synergy between parasitism and marginal nutrition was the base cause for porotic hyperostosis in the region. Thus, climate change caused population aggregation that resulted in extreme crowd disease and poor nutrition. The highest levels of porotic hyperostosis in North America comes from Puebloan sites. This study reveals the causation of those high levels.

**Keywords:** Anemia, nutrient deficiency, Ancestral Pueblo, parasitism

# PALEOPATHOLOGICAL MARKERS OF ECOLOGICAL AND SOCIAL CHANGE DURING THE AFRICAN HUMID PERIOD (C. 11500-5000 BP) IN WEST TURKANA, KENYA

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The African Humid Period (AHP) spans from the Early to the Middle Holocene and had a particularly strong impact on the climate of Northern and Eastern Africa. The AHP was associated with major paleoecological changes characterized by the expansion of lakes and rivers from the Atlantic coast to East Africa, creating a web that shaped a fisher-forager economy. At the end of the period, between ca. 5500-5000 BP, this fisher-forager lifestyle is partly replaced by a pastoralist economy among other technological and social innovations. Did the expansion of fisher-foragers and the later adoption of pastoralism had an influence in the health and mortality among local populations? We assume that such changes represented a major influence on the life of the human groups and that in turn, this would be reflected in a wide range of pathologies on the skeleton. Here, we discuss the paleopathological evidence of how the ecological and social changes during the AHP affected the populations living in West Turkana (Kenya). We present the results of our analyses conducted among the human skeletal collection curated at the Turkana Basin Institute, recovered by research projects lead by the University of Cambridge. Our preliminary results suggest that patterns of traumatic, periodontal and degenerative diseases, among other pathological features, may be related with key ecological and social changes during the AHP. In sum a paleopathological approach to the analysis of human remains is revealed as essential to untangle key changes in our late human evolution in Eastern Africa during the Holocene.

**Keywords:** Paleoeecology, transitions, Holocene, Africa

## A REVISITED CASE OF VIOLENT DEATH DURING THE PASTORAL NEOLITHIC FROM PORCUPINE CAVE (LAIKIPIA, KENYA)

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Porcupine Cave (aka KFR-85), located in Kisima Farm (Laikipia, Kenya), was excavated by A. Siiriainen in the 1970s. The archaeological excavation represented an advancement in the understanding of the funerary practices during the Pastoral Neolithic (PN) in Eastern Africa. Within the anthropological assemblages, Burial 1 (ca. 3329 - 2320 cal BP, according to published literature) contained the remains of an adult male, who was recently the focus of an ancient DNA study. This individual was found with a microlith embedded in a vertebra, and thus also throws light on the study of interpersonal violence, as this primary context is known as the unique evidence of traumatic violence death from the PN. In this poster, we present the results of the re-analysis of the human remains from Burial 1 using new techniques such as microanalysis of the lesion, 3D reconstruction of the biomechanics of the polytrauma and the inclusion of an experimental approach to understand specific lesions. Our study reconstructs the perimortem scenario using an osteoarchaeological perspective linking the paleopathological evidence and the archaeological context with the aim of contributing to the understanding of interpersonal violence during the Neolithic in Eastern Africa.

**Keywords:** Trauma, new methods, experimentation, violence, Neolithic, Africa

# DOCUMENTED HUMAN OSTEOLOGICAL COLLECTIONS AS BIOBANKS: RELEVANCE FOR RARE DISEASE IDENTIFICATION IN THE PAST

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Disease identification in paleopathology relies on the exercise of differential diagnosis, and interpretation. Only a few diseases leave macroscopic pathognomonic traits in bone, and even in cases where microscopic, biochemical and biomolecular analyses are used, diagnosis is invariably inconclusive. Additionally, bone response to a variety of etiologies tends to be homogenous, with mosaic pattern(s) of bone formation and destruction. Therefore, access to pathological cases from human remains of Documented Human Osteological Collections (DHOC) is an exceptional approach. The access to biographical data of the individuals incorporated into the DHOC includes the cause of death, ancestry, sex, age, clinical data and other information akin to clinical data allowing for the possibility of hypothesis-driven research in which bone changes correlate with causes of death - hence providing tested and informed differential diagnosis. In this sense, DHOC may be viewed as a biobank equivalent, i.e. biorepository that stores biological samples for research in the identification of bone changes related to diseases associated with clinical and personal data. This paper will explore known cases of diseases' diagnoses, such as lepra, neoplasias, tuberculosis, syphilis, and diffuse idiopathic skeletal hyperostosis that have used DHOC as diagnostic testing grounds, to explore bone changes and methodological advancements. The paper also introduces the idea of DHOC as biobanks dedicated to the study of rare diseases, as rarely reposted diseases, in paleopathology.

**Keywords:** Health, biorepository, biobanks, DHOC, differential diagnosis

# CHRONIC MAXILLARY SINUSITIS: A COMPARISON OF OSTEOLOGICAL AND RADIOLOGICAL METHODS OF DIAGNOSIS

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Today, Computed Tomography (CT) is a widely established technique to visualize pathological changes in archaeological human remains. The high definition of current CT scanners allows for even small lesions to be visualized, giving osteoarchaeologists a powerful tool to investigate disease in the past. The study of chronic maxillary sinusitis (CMS) has received significant attention in the past years as the presence of CMS is generally considered indicative of poor air quality. We discuss here the methodological implications of using CT scans for diagnosing CMS in contrast to classical endoscopic observation. A total of 32 crania from the Dutch post-medieval rural village of Middenbeemster (AD 1829-1866) were examined both endoscopically and through CT scans. Criteria for identifying CMS included presence of bone spicules and pitting on the sinus walls. 12 cases of CMS were identified endoscopically, and 19 through CT scanning. Statistical analysis revealed no significant differences in scoring CMS endoscopically or through tomographic imaging ( $t_b=0.246$ ,  $p=0.170$ ). When investigating differences among features, no statistical difference was found between spicules observed through macroscopical analysis and computed tomography respectively ( $t_b=0.246$ ,  $p=0.170$ ). The same analysis, however, revealed a statistically significant difference in endoscopically-assessed and CT-observed pitting ( $t_b=0.374$ ,  $p=0.037$ ). Our results suggest that diagnosis of CMS on human skeletal remains can be confidently performed both through endoscopical and radiological analysis, albeit delivering better performances in scoring bone formation in contrast to bone resorption. Further research is being considered to fully explore the role of computed tomography in the study of CMS.

**Keywords:** Radiology, methodology, CT scanning, maxillary sinus, paleopathology

# REVIEW OF INTERVENTIONAL PROCEDURES IN PALEORADIOLOGY AT THE UNIVERSITY HOSPITAL CENTER “ZAGREB”

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Paleoradiology is an indispensable part of paleopathology, but although present for more than 125 years, as a science it is still under-used in everyday practice. It was often used just as an additional feature of case presentation, but today there should be a tendency towards investigations on a larger scale with mere paleoradiology in focus. Besides diagnostic paleoradiology, a move towards interventional paleoradiology should be made, as happened in clinical medicine a long time ago. We present a review of interventional paleoradiological procedures performed at our University Hospital Center, mainly under CT guidance. We describe biopsies and stereotactic positioning. At the end, we would like to offer a perspective on the future of interventional paleoradiology within paleoradiology and paleopathology.

**Keywords:** CT, image-guided, paleoradiology, biopsies, interventional radiology, Croatia

# CINEMATIC RENDERING, A NOVEL PHYSIOLOGICALLY-BASED VOLUME RENDERING METHOD: APPLICATIONS IN PALEORADIOLOGY

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Virtual anthropology as a concept came into focus during the last decade, especially with the development of 3D software capabilities and stronger hardware configurations used in clinical radiology. Virtual anthropology is almost impossible without radiology/paleoradiology, as there are several modes for 3D reconstructions based on CT or even MRI scans. Standard 3D multiplanar (MPR), surface shaded resurfacing (SSD) and volume rendering techniques (VRT) can provide significant new information, but these reconstructions may be more useful to radiologists/paleoradiologists than to anthropologists. A novel physiologically-based volume rendering method, cinematic rendering view, will redefine the concept of virtual anthropology. We shall present its possibilities in paleoradiology.

**Keywords:** CT, 3D reconstructions, cinematic view, paleoradiology, Croatia

# ANTEMORTEM TOOTH LOSS AND OTHER DENTOALVEOLAR PATHOLOGIES IN AN ANTHROPOLOGICAL COLLECTION EXCAVATED FROM A HISTORIC CEMETERY LOCALIZED IN GRODEK ON THE BUG RIVER (11TH – 15TH CENTURY)

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Antemortem tooth loss is now considered one of the problems faced by an aging society. Along with the increase in life expectancy, morphological, anatomical, and functional changes occur in the stomatognathic organ, which often results in the loss of most dentition or even edentulism. Contrary to modern societies, in historic populations, the teeth were lost at an earlier age, which can be considered a form of disability. Taking into account the fact that no effective methods of compensating for the lost functions of the masticatory apparatus were known, the consequences of tooth loss were serious and contributed to a significant reduction in life quality. A skeletal series excavated from Gródek on the Bug River is a good example of illustration for this phenomenon. Among 186 crania, 158 were in a good state of preservation. The main aim of the study was to record the presence of antemortem tooth loss and numerous complications connected to this pathology via macroscopic paleopathological examination supported by radiographic techniques. Out of 158 individuals, only 7 retained full dentition until the time of their death, while the others experienced complications resulting from their tooth loss; 58 (36,7%) individuals experienced the loss of at least 4 teeth, which had a significant influence on the stomatognathic apparatus functions. Frequently noted complications (30,4%) were periapical lesions, including those of severe, life-threatening forms. In order to explain the possible causes of premature tooth loss, the frequency of the physiological skeletal stress indicators was also analyzed.

**Keywords:** Antemortem tooth loss, edentulism, periapical lesions, maxillary osteitis

# MICROARCHITECTURAL AND 3D ANALYSIS OF A NEW PALEOPATHOLOGICAL CASE OF SMALLPOX (AUBETERRE-SUR-DRONNE, CHARENTE, 11TH-19TH CENTURIES)

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Human smallpox was declared eradicated in 1980 by the WHO as a result of massive vaccination campaign. The variola virus (VARV) is one of the most virulent pathogens for humans, belonging to the *Orthopoxvirus* genus, which includes other pathogenic species for animals. Before its eradication and the development of vaccination, smallpox was endemic infection punctuated by epidemic outbreaks, responsible for a high mortality, lethal in one third of adults and one in five children. It is one of the very few viruses causing osteoarticular lesions so-called osteomyelitis variolosa (OMV). Lesions are typical, particularly for the elbow, the most frequently involved joint. These two elements (epidemic frequency and characteristic lesions) make smallpox a subject of interest for paleopathologists. Paradoxically, very few cases have been reported in the paleopathological literature. We present here a possible case of OMV from an ossuary, dated between the 11th and 19th centuries, from the church of Aubeterre-sur-Dronne (France) excavated by HADÈS team from 2010. The specimen corresponds to an incomplete left humerus and ulna fused at the elbow joint in semi-flexion position. A  $\mu$ CT analysis was performed to clarify the architectural and micro-architectural alterations of the joint, in order to support the diagnostic discussion. The results of this paleoimaging analysis showed typical aspects described for the variola infection of the elbow, which permits ruling out other diagnosis and reconstructing physiopathogeny of the changes. It also allowed us to propose an alternative terminology better suited to the description of the osteoarticular damage in smallpox.

**Keywords:** Smallpox, VARV, osteomyelitis variolosa, paleoimaging

# COMMINGLED HUMAN SKELETAL REMAINS FROM A GRAVEYARD PIT – THE VALUE FOR PALEOPATHOLOGICAL STUDIES: A CASE STUDY FROM HELSINKI, FINLAND

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Commingled human remains comprise assemblages of intermixed skeletal remains from several individuals. They represent a primary burial of bodies deposited simultaneously or result from a secondary burial event with collecting and transfer of human remains from their original burials to a single new location. Individuals of both genders and various ages could be disarticulated, fragmented and dispersed within the assemblage. The value of commingled skeletal remains for paleopathology is discussed with the secondary burial pit L514 as an example. It was excavated in 2020 as part of archaeological field work at Senaatintori in Helsinki. At the current west side of Senaatintori, there were during the Swedish rule a church and its graveyard in use AD 1640–1790. In 1809 Finland became an autonomous grand duchy of the Russian empire. Over the next decades the church was demolished, and graveyard leveled for the new administrative city center. In 2020 over one hundred single burials and the bone pit L514 were excavated, documented and analyzed. Pit L514 revealed 961 bone fragments with a minimum number of 28 individuals of both genders and age-at-death ranges from infant to 50–60-years. Stature estimations, developmental disorders and nonmetric traits were recorded. Pathological lesions comprised dental diseases, degenerative and inflammatory joint diseases, malnutrition-related lesions and osteomyelitic lesions suggestive of systemic bacterial infection. Some bone modifications were suggestive of habit or work-related origin. The commingled bone assemblage revealed new information on the population of Helsinki and provided a wider perspective to the microhistory of the city.

**Keywords:** Commingled, graveyard, paleopathology, AD 1640–1790, Helsinki

# CLIMATE CHANGE, MORTALITY CRISES, AND HEALTH IN MEDIEVAL ENGLAND

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The 14<sup>th</sup>-century Afro-Eurasian pandemic of plague, now often referred to as the Black Death, was one of the most devastating pandemics in human history. In England, it killed an estimated 30-60% of affected populations and emerged in the context of intense population pressures, increasing social inequality, increasing urbanization and changing global climatic conditions associated with the end of the Medieval Climate Anomaly. Thus, the prelude to and experience of the Black Death in England can provide a model for better understanding the confluence of urban environments, climate change, and emerging diseases. This paper presents analyses of skeletal data from people buried in several London cemeteries and who died before the Black Death emerged (c. 1000-1250 CE, n = 502) and specifically tests the hypothesis that health in general was on the decline prior to the Black Death in the context of climate change and subsistence crises, which might have implications for understanding why mortality during the Black Death was so extraordinarily high. The results of Kaplan-Meier survival indicate significant reductions in survivorship in the 13<sup>th</sup> vs. 11<sup>th</sup>-12<sup>th</sup> centuries. Simultaneously, rates of developmental stress markers (linear enamel hypoplasia and short adult stature) increased in the 13<sup>th</sup> century. Overall, these results suggest a health decline prior to the Black Death in England. Given that selective mortality during famines before the Black Death might have produced surviving cohorts with relatively low average frailty, more work needs to be done to clarify the connections between pre-pandemic conditions and outcomes during the Black Death.

**Keywords:** Plague, survivorship, famine, Black Death, frailty

# THE PATHOCENOSIS OF INFECTIONS IN THE PAST: A UNIFIED VIEW OF PALEOPATHOLOGICAL AND PALEO- PARASITOLOGICAL APPROACHES

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Paleopathology and paleoparasitology have the same roots, since they are known to have the same father, Marc Armand Ruffer. These two sister sciences developed independently: paleopathologists early joined the community of biological anthropologists, while paleoparasitologists, mostly coming from archaeology, environmental and health sciences, maintained their activity in these fields. Over the past three decades, with rapid advances in molecular biology, a growing number of specialists in clinical microbiology, molecular biology, and bioinformatics have become interested in the evolution of host-pathogen relationships. Paleomicrobiology offers new opportunities to understand the origin, dispersal, pathogenicity and virulence of pathogens in the past, as well as their direct or indirect relationships with humans. By encompassing all species (bacteria, fungi, viruses, and parasites, including ectoparasites) that can be identified in archaeological contexts, molecular-based studies of ancient pathogens can effectively strengthen the links between paleopathology and paleoparasitology. Host-pathogen relationships must be conceived as a whole, taking into account the complex pattern of multi-host-multi-pathogen biology considered in an ecological and evolutionary framework. Among the holistic approaches to the evolutionary ecology of diseases is the concept of “pathocenosis”, coined in 1969 by Mirko Grmek, a medical historian and paleopathologist. Basing his model on that of the biocenosis, he defined pathocenosis as the sum of disease states present in a given population at a given time, whose distribution and frequency depend not only on endogenous and ecological factors, but also on their interdependence. The concept of pathocenosis would thus bring together paleopathology, paleoparasitology and paleomicrobiology in a unified vision of infectious diseases in the past.

**Keywords:** Paleopathology, paleoparasitology, paleomicrobiology, pathocenosis

# NATURAL HISTORY OF OSTEOMYELITIS: OLD BOOKS FOR OLD BONES

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Odilon Lannelongue (1840-1911), is a French surgeon, author of a seminal study on child osteomyelitis (1879). It is thanks to him that Louis Pasteur identified in 1880, *Staphylococcus aureus* from a pus sample of a young patient. This bacterium has been, until recently, the main pathogen responsible for bone and joint infections. Lannelongue's book is of great interest to paleopathology. Since deaths at hospital (50% of mortality within days or weeks) were followed by autopsies, the author mentioned that skeletal changes are already visible 2 weeks after the first clinical signs appear. Thus, acute osteomyelitis may escape the osteological paradox, according to which acute fatal diseases produce 'healthy' skeletons, because death occurs before bone tissue reacts. In case of survival, the infection becomes chronic, alternating temporary healings and recurrences over several years. These chronic forms are easily detected in paleopathological practice. However, there is a discrepancy between the high frequency of osteomyelitis described in medical records from the 19th century and the scarcity of paleopathological references. Osteomyelitis is not rare in osteoarchaeological series, it is just neglected. In a personal unpublished study of a few hundred archaeological skeletons (late medieval-early modern periods), more than a dozen cases of chronic osteomyelitis were identified. These amounts could be even greater if paleopathologists concentrated on children's skeletons, on the study of acute forms, responsible for rapid death, but detectable on the skeleton even at these early stages, as described in Lannelongue's study. This illustrates the value of ancient medical books for improving our knowledge in paleopathology.

**Keywords:** Osteomyelitis, history of medicine, paleopathology

# A RADIOLOGICAL ATLAS OF THE TYROLEAN ICEMAN: ARCHIVING AND ANALYSIS OF ALL RADIOLOGICAL RECORDS OF “ÖTZI”

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Over the past three decades since his discovery at the Tisenjoch on September 19, 1991, the 5300-year-old Tyrolean Iceman has become the radiologically best-documented mummy in history. Meanwhile, there are over 50 publications focusing on the radiological findings of “Ötzi”. We are currently working on an atlas that illustrates all of these radiological findings using the latest CT imaging data from 2021 and comparing those to the original imaging data, now fully digitized for the first time, as part of a third-party funded project. In this report, we will present selected findings from our project and highlight methodological challenges and improvements implemented during the latest image acquisition in 2021.

**Keywords:** Radiological atlas, Tyrolean Iceman, imaging data

## TWO RECENT ADVANCEMENTS IN IMAGING DIAGNOSTICS OF ANCIENT HUMAN REMAINS

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Paleoradiology requires specific adaptations and developments to account for the wide variety of findings, potential postmortem alterations, and circumstances often arising from limited transportability or remote find locations of unique ancient biological specimens. We present two recent advancements from our ongoing research in imaging diagnostics of ancient human remains:

- Specialized MRI sequences, such as ultrashort or even zero echo time sequences, may help overcome the particular challenges arising from the low hydrogen (1H) content and short transverse relaxation times (T2 or T2\*) of mummified tissues. We present the results of a collaboration with our partners from ETH on applying a zero echo time-based hybrid filling technique in combination with a custom-engineered gradient insert.
- A low-cost device for acquiring cross-sectional images of specimens in remote areas and under demanding field conditions is of great interest for bioarchaeological research. We present our recent in-house development of a fully portable X-ray tomographic imaging setup for specimens up to 400 mm in diameter delivering isotropic resolution as low as 100  $\mu\text{m}$ .

**Keywords:** Advancements and adaptations in paleoimaging, specialized MRI sequences and hardware, portable X-ray tomographic imaging setup

# LIVING AND SURVIVING IN THE ROMAN EMPIRE: SKELETAL TRAUMA AND STRONTIUM ISOTOPES OF AN INDIVIDUAL FROM LUCUS FERONIAE (ROME, ITALY)

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The study of archaeological human remains allows us to dive deeply into the lifestyle of past populations. When applied to the Roman Empire, it can shed light on the life of a part of the population that was not reported by classical literary sources. In particular, slaves played a fundamental role in the Roman Empire, both in the city of Rome and in outer villages. Our study focuses on the necropolis outside the village of Lucus Feroniae (I-III century CE). From the archaeological record we know that the village was inhabited by local people, war veterans and *liberti* (freed slaves). Combining macroscopic examinations and radiographic analyses of a subsample of individuals from this necropolis, we were able to identify an adult male with signs, on the skull and postcranial bones, indicative of a harsh life. These are features that, in the literature, are normally associated with a low social status. To explore the life history of this individual we coupled the skeletal evidence with an isotopic study, as to infer the origin of this man and his possible role within the community. Hence, we measured the strontium isotope ratio in the enamel of the second molar to study his geographical origin. The integration of isotopic, skeletal, and archaeological data helps to reconstruct the osteobiography of this man, providing an insight into the life of the lower class in Imperial Rome.

**Keywords:** Bioarchaeology, paleopathology, strontium isotope ratio, Roman Empire, Italy

# CONTESTED SPACES: REVISITING THE EARLY IRON AGE MASS GRAVE FROM GOMOLAVA, SERBIA

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Since its discovery in 1971 the Early Iron Age mass grave from Gomolava, Serbia, has been interpreted as the result of an epidemic. Located at the river Sava, between the Carpathian Basin and the Balkans in Western Serbia, Gomolava is situated at the border of diverse traditions and competing lifeways during the early 1st millennium BC. This period saw cultural and population changes that impacted on social networks and life experiences. How did these highly transformative processes express themselves in the remains of those who lived through them? A recent re-analysis of the human skeletal remains from Gomolava as part of The Fall of 1200 BC project (European Research Council GA #772753) examined health and lifeways to explore the reasons for the burial and violent deaths of at least 77 people, predominantly children and women. Based on the bioarchaeological and biomolecular findings, this presentation is going to re-evaluate the story of the grave and the role that conflict and violence played in negotiating contested spaces in the Carpathian Basin in the 1st millennium BC.

**Keywords:** Conflict, violence, prehistory

# TRYPANOSOMA CRUZI IN ARIZONA: DOES THE MODERN DISTRIBUTION SUGGEST PREHISTORIC PARASITISM?

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There is growing concern in the United States that climate change may produce distribution shifts and host-switching in local triatomine (kissing bugs) populations. A potential consequence could be increases in autochthonous cases of Chagas' disease (American trypanosomiasis) in both humans and domestic animals. Natural *Trypanosoma cruzi* infections have been documented in 7 of the 10 native Triatomines species found in the USA. While many of these species remain sylvatic or peridomestic annoyances, a few seem to be progressing to virtual, if not complete, domiciliation. While historic accounts of kissing bug annoyance in the USA help to establish the recent evolution of this health dilemma, there is a paucity of information concerning prehistoric antecedents of the human-Triatomine interface. Unfortunately, except for probable megacolon in a prehistoric mummy from Texas, the evidence is limited. A data base that appears useful for illustrating the likelihood of kissing bug infestations at prehistoric communities in the America Southwest was generated by Sherwin and Fae Wood during their 1952-1978 surveillance of triatomines at national monuments in Arizona. Six sites were sampled with 431 bugs representing 3 species collected. Sixteen (3.7%) bugs tested positive for *T. cruzi*. Several risk factors can be identified at these prehistoric communities that would provide kissing bug habitat making the potential for *T. cruzi* infections a likelihood. While the paleopathological considerations are valuable by themselves, in a One Health perspective, they also provide a more complete picture of the effects kissing bugs have had on human and animal health in the state.

**Keywords:** *Trypanosoma cruzi*, triatomine, climate change, Chagas disease, One Health

# A PATHOLOGICAL LESION OR A POST-MORTEM ARTIFACT? AN INTERDISCIPLINARY APPROACH TO DEAL WITH AN INTERESTING EARLY MEDIEVAL CASE

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In 2018, during archaeological research taking place in Staré Město, near Uherské Hradiště (Czech Republic), 23 early medieval graves with 26 skeletons were excavated. Many of the skeletons were buried in very special positions. Grave No. 7/2018 contained a young male skeleton lying on his back with the upper limbs bent extremely at the elbows and hands almost touching the shoulders. Only morphological methods considering the skull could be applied to assess the sex of the individual. Age at death estimation was based on skeletal maturation stage and dental wear. To evaluate the health status, macroscopic examination of the skeleton, supported with radiographs and CT scanning where necessary, was the basic method employed. Except for severe dental diseases and pathological changes probably caused by juvenile arthritis, X-ray examination revealed unusual dense structures in the mandible of the individual. However, their appearance was not particularly consistent with any known pathology. Based on the results of CT scanning, it was hypothesized that these were cavities filled with unflooded sediment. To prove this, the samples from the mandible were measured by X-ray fluorescence spectrometry (XRF), focusing on the determination of the content of silica, calcium, and phosphorus. The measurement results show a higher intensity of silica in the samples of the affected area than in the reference sample, which supports the above-mentioned hypothesis. The case illustrates the usefulness of interdisciplinary collaboration in dealing with paleopathological alterations in archaeological bones and the importance of differentiating true pathologies from post-mortem alterations to avoid inappropriate interpretations.

**Keywords:** Pseudopathology, XRF, CT scanning, Early Middle Ages

**Funding agencies:** The study was carried out through the institutional support of long-term conceptual development of research institutions provided by the Ministry of Culture (ref. MK000094862).

# BREAST CANCER IN THE 17<sup>TH</sup> CENTURY: THE TWO WIVES OF LUIS GUILLERMO DE MONCADA

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The mummified and skeletonized remains of nobles buried in the Neapolitan Basilica of San Domenico Maggiore (15<sup>th</sup>-17<sup>th</sup> century) constitute an important series with regard to paleo-oncology, since three of the five cases of soft tissue tumors known in paleopathology worldwide are documented in this Italian series. In this study, we focused our attention on the new cases of cancer of the princesses Moncada: Maria Afán de Ribera (ca. 1615-1639) and Catalina Moncada de Castro (1611-1659). The study was performed by macroscopic and radiological analysis of osteological remains of the two noblewomen and by the investigation on 17<sup>th</sup> century archival sources in order to obtain an accurate retrospective diagnosis. The radiological documentation allowed to detect some focal neoplastic osteolytic lesions in the skeletal remains of the two noblewomen. These lesions supported a diagnosis of metastatic carcinoma, but the historical and archival sources were fundamental to diagnose breast cancer in both individuals. The two new cases of breast cancer must be added to the three malignant tumours previously known from the aristocratic series of San Domenico Maggiore in Naples (15<sup>th</sup>-17<sup>th</sup> century). Therefore, out of a total of eighteen adult individuals, five (28%) were affected by cancer. Despite the small sample size, this prevalence is surprisingly comparable to that of the contemporary Western world.

**Keywords:** Breast cancer, paleo-oncology, 17<sup>th</sup> century medicine, Moncada, Naples

# PREVALENCE OF ANENCEPHALY IN TWO ARCHAEOLOGICAL COLLECTIONS IN PORTUGAL

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Anencephaly is a specific congenital anomaly that mainly affects the skull and is the result of a problem that occurs in the neural tube during embryonic development. It occurs when there is no correct closure of the sutures and still underdevelopment of the brain. It represents a pathology with a high mortality rate and babies with this pathology end up dying shortly after birth. This communication aims to present two case studies of non-adults with anencephaly, both with an age at death of approximately 4.5 months, from two different archaeological interventions in Portugal. One from the Colégio de Jesus in Coimbra and another from the Convent of São Domingos, in Lisbon. Both necropolises belong to the Modern and Contemporary Ages (XIII – XIX centuries). The skeletons under study were qualitatively analyzed macroscopically. Metric analysis of the long bones of each of them was performed and subsequently X-rays and three-dimensional models. Both cases in the study were born without the upper region of the skullcap. In this way, it is intended to contribute to the study of this pathology since cases of anencephaly registered today are very rare, thanks to advances in medicine.

**Keywords:** Anencephaly, congenital anomaly, pathology, non-adults, X-rays

# EARLY EVIDENCE OF LEPROSY ALONG THE CHANG'AN REGION IN THE TAN DYNASTY, CHINA

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Leprosy, a chronic specific infectious disease caused by *Mycobacterium leprae*, has been widely reported in paleopathological studies worldwide. In this study, we report a case of leprosy from Xingfulindai Cemetery, central China, from a male individual who died at the age between 25 and 30 years. Epitaphs and grave goods show that he died in the tenth century AD. The skeleton coded as M446 was examined through macroscopic examination, microscopic observation and digital radiography. Results demonstrated that osteolytic and osteogenetic reactions were found on the nasal, palatine process of maxilla, zygomatics and the superciliary arch; osteoporosis, osteolytic and porous morphology, alongside with braided or inlaid new bone deposition, were present on the distal extremity, especially metacarpals, metatarsals and hand phalanges. Lesion distribution and characteristics indicated that leprosy was considered the most likely diagnosis, with differential diagnoses of treponemiasis, psoriatic arthritis, sarcoidosis, diabetes, lupus vulgaris and mold infection. This rare case unearthed in a commoners' public cemetery not only enriches our understanding of the paleoepidemiological patterns of leprosy, but also illuminates that the social stigma of leprosy was not rooted in popular belief in the Tang dynasty.

**Keywords:** Leprosy, nasopalatine syndrome, osteolytic reaction, osteoporosis, Tang dynasty

# ATHEROSCLEROTIC CALCIFICATIONS, MULTI-JOINT OSTEOARTHRITIS AND OTHER HEALTH CONDITIONS IN TWO SKELETONS FROM LARGO DO CARMO, LISBON (15TH-18TH CENTURIES)

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This work aims to present and discuss a group of pathological changes observed in two old individuals exhumed from Largo do Carmo, Lisbon. These individuals, a female (Sk. 1) and a male (Sk. 2) were exhumed in 2014 and 2015 and belong to an assemblage of circa 250 individuals (still under study), dated from the 15<sup>th</sup> century to 1755. The macroscopic analysis of the two individuals, who were fragile but fairly complete, revealed severe multi-joint osteoarthritis (OA), affecting more than six synovial joints, bone fractures, and rare calcifications. While Sk. 1 showed more bilateral OA lesions on the shoulder girdle, those of the elbow and hip were more notorious in the second individual. Both showed fractures on the distal radius and ribs, probably osteoporotic. Atherosclerotic calcifications were recovered in both individuals. Tubular calcifications (110 mm), close to the left and right femur of Sk. 2 and two irregular calcified masses (20 mm and 50 mm) on the abdomen of Sk. 1. The former resembles a case of femoral artery calcification, the latter calcified fibroid. Clinically, bodyweight and aging, as biomechanics, are strongly related with multi-joint OA. Aging and systemic conditions (e.g., diabetes mellitus, coronary artery disease) also predispose peripheral arterial calcification. The uncommon cases reported are relevant to understand longevity, lifestyle and disease in the past.

**Keywords:** Atherosclerotic calcifications, generalized osteoarthritis, osteoporotic fractures, medieval Lisbon

# HOW ANTHROPOLOGY STUDENTS AND PROFESSIONAL BIOANTHROPOLOGIST PERCEIVE NEW BONE FORMATION IN SKELETAL REMAINS? A PRELIMINARY RESULT OF TWO COMPLEMENTARY ANALYSES, GROSS AND RADIOLOGICAL EXAMINATION IN PORTUGUESE MEDIEVAL OSTEOLOGICAL COLLECTIONS

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Periosteal bone formation (PBF) is difficult to characterize in skeletal remains due to their nonspecific etiology. The aim of this study is to evaluate how bioarchaeologists, with different levels of expertise, perceive naked eye and radiological PBF on dry bone. Students (n=27) and professional bioarchaeologists (n=5) completed two questionnaires, using a Likert scale, after the gross and radiological examination of six tibiae (3 left side and 3 right side) from Portuguese medieval osteological collections. The results show that there is an agreement on how individuals recognized that they know to macroscopically identify 'lamellar' (96.9%) and 'woven' bone (96.9%), but not a 'vascular impression' (48.4% know the word, and 32.3% know how to identify). Nonetheless, when asked to macroscopically identify this same evidence in dry bone, their perception of the terms is not homogeneous between knowing and identifying. They were able to identify 'cortical thickening' (84.6%), 'irregular bone contour' (88.8%), and 'periosteal reaction' (96.3%), on conventional radiology and computed tomography slices of the same six tibiae. We verified agreement of results on 'cancellous' bone with 100% and 'cortical' bone with 96.3%, and these were the exceptions. Moreover, 73.7% of the individuals agree that 3D reconstructions are helpful for radiological analysis. This preliminary study demonstrates the importance of establishing more specific criteria to

differentiate PBF resulting from periosteal activity during lifetime. Digital anthropology and paleoradiology is also perceived as having an important role in characterizing PBF and the relationship between bioanthropology and the techniques of biomedical imaging should be reinforced whenever possible.

**Keywords:** Lamellar bone, woven bone, vascular impression, periosteal reaction, radiology

**Funding agencies:** This study was supported by the Research Centre for Anthropology and Health (CIAS / UIDB/00283/2020). Inês Leandro is supported by Fundação para a Ciência e Tecnologia (SFRH/BD/122198/ 2016).

# THE CASE OF TOMB 10, MORRIONE: A RARE CRANIAL PATHOLOGY FROM THE EARLY MIDDLE AGES

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This work presents the case of the individual from tomb 10 of the VII century CE necropolis of Morrione, Campochiaro, Molise, Italy. This necropolis, along with the necropolis of Vicenne, are important to the understanding of migrations of Early Medieval European populations, as they present a unique burial ritual consisting of single warriors deposited along with weapons, horse-tack, and horse within the same pit. Tomb 10 consists of an adult mature (40-50yo), male buried with horse, making him part of the “horsemen” elite of the site. The state of preservation of the individual is poor, nonetheless the cranium presents bi-lateral sulci on the frontal bone in connection with both the ophthalmic artery and the orbital surface. These structures were investigated using CT scanning, with data elaborated in Amira software in order to extrapolate the internal composition. These structures do not conform to taphonomy and are characterised by an inflammatory boney response to a pathological process that possibly affected the circulatory system and the eyes. As this condition is rare, if not unknown, in paleopathological literature, we believe the most likely cause to be a form of giant cell arteritis, also known as temporal arteritis. This condition appears progressive and painful, inducing at least partial blindness during the lifetime of the individual. If so, it is likely that the individual has received assistance, care, and community support as well as a lack of social stigma, noting his funerary ritual and central burial position.

**Keywords:** Paleopathology, inflammation of the frontal bone, giant cell arteritis, Early Middle Ages, horseman burial

# ADVANCEMENTS IN THE MOLECULAR DETECTION OF CONCURRENT DISEASES AND CO-INFECTIONS IN PAST POPULATIONS

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The detection of infectious disease in individuals from archaeological contexts can be hindered by the lack of historical documentation and absence of diagnostic skeletal changes. These ambiguities can confound our understanding of the complexity of past epidemiological events. Molecular methods for pathogen detection are valuable tools that can further inform our interpretation of historic and prehistoric outbreaks. Large-scale DNA sequencing and high-resolution bioinformatic technologies now permit sensitive, broad, and simultaneous screening for multiple agents of disease within a given population, burial or individual, allowing identification of candidate pathogens for targeted genomic analysis. Results from eight burial sites across Central Europe will be highlighted. Shotgun sequencing combined with an advanced computational pathogen screening pipeline revealed the presence of multiple pathogens, including *Salmonella enterica* subsp. *enterica* (paratyphoid fever), *Treponema pallidum pertenuis* (yaws), *Mycobacterium leprae* (leprosy), *Borrelia recurrentis* (relapsing fever) and *Yersinia pestis* (plague). Three individuals were found to be afflicted with co-infections at the time of death, and

two instances of concurrent infections were also uncovered. Employment of enrichment methods following detection allowed for the generation of several genomes for comprehensive analyses. This research demonstrates the ability of these methods to reveal coinfections and concurrent disease in historical populations and brings new insights into the perceived disease ecologies of past populations that may otherwise not be brought to light.

**Keywords:** Metagenomics, pathogens, aDNA

# BRIDGING THE GAP: ANTHROPOLOGICAL AND ARCHAEOZOOLOGICAL PERSPECTIVES ON ACHONDROPLASIA – PART TWO

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This presentation follows up on the research questions on achondroplasia addressed in Part One, covering the evidence for this condition from the archaeozoological record. Although achondroplasia is today classified as rare in humans, its animal parallel is often the result of selective breeding in domesticated species, driven by hyper-specialized functional activities and/or by esthetic criteria, and it occasionally appears in wild groups. In striking contrast to the evidence from non-domesticated species, the key role played by selective breeding in promoting the genes responsible for achondroplasia in animals blurs the boundaries of the definition of this condition as a disease, even more strongly as a rare disease. The literature review presented here will take stock of the archaeozoological studies on achondroplasia in domestic and wild species, and it will outline the main methodological issues in diagnosing it. The data presented here will show that, in a human – animal comparative approach, the application of shared language and diagnostic criteria can lead to a better understanding of the pathognomonic bone changes, as well as the history and evolution of rare conditions, such as achondroplasia. We show that such comparative approach is already successfully applied by medical studies on contemporary cases of achondroplasia, making even stronger the need to implement it in paleopathological research.

**Keywords:** Achondroplasia, archaeology, paleopathology

# ORAL HEALTH OF A MODERN AGE POPULATION FROM SARDINIA (16<sup>TH</sup> CENTURY)

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This research examines a set of dental health indicators, including caries, tooth wear, periapical lesions, periodontal disease, ante-mortem tooth loss and calculus, of a population of the 16<sup>th</sup> century from the city of Alghero, Sardinia (Italy). The present research is the first conducted on a large skeletal population from the island and is aimed at investigating the oral pathologies of this group and to verify if they correspond to the patterns of dental health of the Modern Age. The cemetery is associated with the plague outbreak that ravaged the city in 1582-1583; 160 individuals were examined, among which 81 were adults and 79 non-adults. This sample from a catastrophic cemetery can therefore provide an unbiased picture of the demographic and epidemiological characteristics of the original living population. In the population from Alghero a high frequency of carious lesions, periodontal disease, AMTL, and calculus was observed; on the other hand, periapical lesions were infrequent and moderate tooth wear was recorded. In general, no statistically significant sexual differences are observed, evidencing equal and uniform access to diet and dental hygiene for both males and females. The non-adult subsample shows the same pattern of caries as the adults and is affected by calculus. The patterns of oral health observed in the Alghero population fit with the data recorded in other Modern Age samples, reflecting a diet rich in soft and refined food prevalently based on carbohydrates, associated to a scarce oral hygiene, as documented during the transition from the Middle Ages to the Modern Era.

**Keywords:** Oral pathologies, caries, periodontal disease, calculus, dental wear, post-medieval period

# BRIDGING THE GAP: ANTHROPOLOGICAL AND ARCHAEOZOOLOGICAL PERSPECTIVES ON ACHONDROPLASIA – PART ONE

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This presentation focuses on a literature review of cases of achondroplasia and, together with the presentation on archaeozoological data, it aims to discuss the advantages of a combined human-animal perspective in approaching the paleopathological evidence for rare conditions. The definition of achondroplasia covers a spectrum of growth disruption syndromes stunting body height and affecting body proportions. Although this condition is today classified as rare, it remains one of the most frequently documented from the osteoarchaeological record. The authors will review the last 50 years of paleopathological literature in order to address issues of diagnostic procedures and of public visibility of cases of achondroplasia. This discussion will also focus on the embodiment of social constructs by the affected individuals, stressing the interconnection between changes in public perception of this disease through time and its evolution. The cases of achondroplasia presented here show that the persisting dichotomy between human and animal paleopathology hinders critical approaches to diagnostic methods in paleopathology. Furthermore, we maintain that a global paleopathology of rare conditions can be successfully advanced only by understanding the pathological pathways behind the changes caused by them in human as well as in animal bones.

**Keywords:** Achondroplasia, archaeology, paleopathology

# WHEN LESS IS MORE - PALEOPARASITOLOGICAL ANALYSIS OF SOIL SAMPLES FROM THE PUCK SITE IN NORTHERN POLAND

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In 2019 archaeologists from the University of Warsaw excavated a cemetery dating from the 14th to the 18th century located at the parish church of Puck. This town was established in the 14th century in the Puck bay. The purpose of the project was to analyze the diet and hygiene of the individuals and to supplement the information gathered during the archaeological excavations carried out in the city, along with data from the zooarchaeological analysis. Based on the location of the site on the sea coast and the artifacts discovered during the excavations, the main hypothesis of the project was that except for the most common parasites (*Trichuris trichiura*, *Ascaris lumbricoides*) the samples might contain fish parasites. Soil samples were therefore collected from the pelvis and the skull of 22 individuals and analyzed in the laboratory with the standard RHM protocol, as well as examined under the microscope. The species identification was based on size, shape, color, and morphological features of the eggs. Three out of 44 samples (graves 13, 36 and 83) contained eggs of *T. trichiura* and *A. lumbricoides*. All eggs were characterized by very good preservation. The small number of positive samples is surprising, especially in comparison to other Polish sites coeval to Puck. The preservation of these eggs indicates that their small number might not be a result of taphonomic processes, but due to a lack of parasites in the intestines. Since fish consumption in Puck is well-documented by written sources and archaeological finds, these results may suggest the existence of methods of fish preparation before consumption.

**Keywords:** Middle Ages, Early Modern Period, diet, Pomerania, fish

## TUBERCULOSIS AND IRON AGE PIT BURIALS

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During 2020, as part of a residential development and associated landscaping and infrastructure project, Archaeological Research Services Ltd. conducted archaeological works near Banbury, Oxfordshire, United Kingdom. The excavation revealed the human remains of nine individuals, each deposited in a separate large pit and spanning a period radiocarbon dated to 406-172 cal BC (95.4% probability). All of the individuals presented a series of pathological lesions, including endocranial changes of all observable skulls. The analysis aimed to characterize the lesions and subsequently consider their etiology. This was achieved using macroscopic methods of investigation as well as digital photography and light microscopy. The latter was undertaken using a Dino-Lite Edge microscope with DinoCapture 2.0 imaging software, at various magnifications. Four individuals showed endocranial granular impressions (GI), previously proposed as pathognomonic of meningeal tuberculosis, whereas further five skeletons presented a mosaic of features suggestive of the disease. These findings, represent, along with the individual from Tarrant Hinton (Dorset), the earliest reported instances of tuberculosis in the Iron Age British Isles and provide the first example of a community-level infection.

**Keywords:** Tuberculosis, Iron Age, pit burials

# FREQUENCY OF IGD OCCURRENCE IN INDIVIDUALS FROM CREMATION GRAVES OF THE LUSATIAN CULTURE FROM SW POLAND

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The occurrence of interglobular dentin (IGD), attributed to vitamin D deficiency, was not tested for cremated human remains from prehistoric burials, although it was proved to be observable on slides prepared from laboratory-burned teeth. The study examined 23 individuals from 6 Lusatian culture (ca. 1300-400 BC) cemeteries for IGD presence. A total of 26 teeth were tested: 2 deciduous teeth roots, 3 germs and 21 roots of permanent teeth. The FDI system was used. Transverse histological slides were prepared following the Plenk procedure. The occurrence of IGD was assessed as present or absent. The age of IGD formation was assessed according to Brickley and co-workers. Out of the 23 individuals, IGD absence was observed in one individual. The presence of IGD was identified in all slides obtained from the germs and upper parts of permanent teeth roots. The presence of IGD was not observed in the roots of deciduous teeth, but IGD was identified in the permanent tooth germ of the same individual. The age of IGD formation was estimated at around 2 to 5 years. The absence or presence of IGD is clearly recognisable on cremated teeth from archaeological contexts. The age of IGD occurrence estimation is difficult, as only fragments of roots are preserved. High IGD frequency observed among the examined individuals provides insights into the appropriateness of its interpretation as a vitamin D deficiency indicator. The occurrence of IGD should be considered in a broader context of metabolic and nutritional stresses.

**Keywords:** Interglobular dentin, vitamin D deficiency, cremated human remains, Late Bronze/Early Iron Age, Urnfield culture

**Funding agencies:** The research was carried out as a part of research project no. UMO-2018/29/N/HS3/00887, 2019/32/T/HS3/00292, funded by the National Science Center, Poland.

# OTITIS MEDIA AND NON-SPECIFIC POROSITIES IN THE PETROUS BONE IN POST-MEDIEVAL SKELETONS FROM COPENHAGEN

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Infectious diseases have often been associated with poor sanitation and living conditions, and often found to be more severe in urban more densely populated settings. The aim of this study was to estimate the frequency of otitis media (OM) in four post-medieval (1600-1850) Copenhagen cemeteries, as deduced from CT-scanning of the temporal bone, and to compare the results to other studies. Chronic OM in childhood may result in hypopneumatization of the temporal bone, which, once formed, persist into adulthood and thus can serve as an indicator of OM in childhood years. We also investigated the association between hypopneumatization on CT imaging, non-specific porosities of the endocranial surface of the petrous bone and pathological changes to the tympanic cavity. In total 94 adult individuals from Holmens Kirke (n=27), Bremerholmens Kirkegård (n=34), Upsalagade 22 (n=24) and Trinitatis Kirke, Pilestræde (n=9) were included. All petrous bones were CT scanned for hypopneumatization, scored with regards to endocranial porosities and examined otoscopically. We found that 31,9% of the included individuals had CT findings consistent with OM, which is similar to past studies of medieval and post-medieval European populations. No association between the three applied methods was found, except for an almost non-existent agreement ( $\kappa=0,09$ ) between the presence of endocranial porosities and tympanic cavity changes. Further studies are needed to develop better methods to diagnose OM in past populations, as the disease bears much information about childhood health and exposure to infectious disease.

**Keywords:** Otitis, paleopathology, Middle Ages, Denmark

# SAMPLING, EXTRACTION AND ANALYSIS OF ANCIENT DNA FROM MINERALIZED TISSUE FORMATIONS

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Mineralized tissue formations, such as bladder-, kidney- or gallstones are a rare finding in archaeological excavations, even though they were likely not uncommon in past human populations. They can, however, be a valuable source for both host and pathogen DNA. The formation of such calculi can be linked to diet and hydration, metabolic diseases, tumors and metastases, as well as chronic and infectious diseases. Especially the latter two can be of great interest when studying pathogens, as they become enclosed in the course of formation. However, as the archaeological record is sparse, not many objects have been studied yet regarding ancient host and pathogen DNA. During the 19th century in Vienna, surgeon and urologist Leopold von Dittel had collected numerous different calculi, that are - together with a variety of other ancient stone formations – stored in the Pathological-anatomical collection of the so-called Narrenturm. Here, we present preliminary genetic data of a pilot sample set of calculi from this collection. We explore different sampling strategies, such as incubation in extraction buffer to best preserve stone formations, while still obtaining enough DNA for analyses to both quantitatively and qualitatively assess host and pathogen DNA as well as species composition across different sample types. First results indicate an overall very good DNA preservation for most calculi other than gallstones, where human DNA content is lower. Using metagenomic tools, we assessed microbial species. The calculi are very heterogeneous regarding species and differ also within the same type of sample.

**Keywords:** Mineralized tissue formations, calculi, ancient DNA, sampling strategies, pathogens, disease

# EXPLORING DIET AND DENTAL DISEASE AMONG NAPOLEONIC SOLDIERS THROUGH BIOCHEMISTRY AND PALEOPATHOLOGY

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Integrating stable isotope and pathological analyses provides valuable insight into the relationship between diet and oral health in the past. We employed stable carbon and nitrogen isotope analysis of femoral collagen, which captures longer-term diet, and rib collagen, which captures later life diet, to investigate the relationship between diet and dental disease among Napoleonic soldiers (n=38) from the 1812 mass gravesite of Šiaurės miestelis in Vilnius, Lithuania. We focused on the following dental pathological conditions: caries index (number of carious teeth divided by teeth observed) and lesion severity (mild, moderate, and severe), number of abscesses, and antemortem tooth loss. Stable isotope results indicate that Napoleonic soldiers consumed heterogenous diets longer-term and later in life, including terrestrial grains and vegetables, terrestrial meat, and possibly freshwater fish. Multiple regression model results indicate that a statistically significant amount of variation in mild caries (p=0.03) and moderate caries (p=0.0009), but not severe caries (p=0.61), caries index (p=0.08), abscesses (p=0.65), or antemortem tooth loss (p=0.46) can be explained by variation in femoral and rib stable carbon and nitrogen isotope values. Additionally, 37% of variation in mild caries and 50% of variation in moderate caries can be explained by variation in stable isotope ratios. Thus, while longer-term and later life diets explain some variation in some dental pathological conditions, other sources likely account for remaining variation including tooth morphology, oral hygiene, and hormones.

**Keywords:** Stable isotope analysis, oral health

**Funding agencies:** This research was funded by the University of Georgia, Sigma-Xi, and the Baltic-American Freedom Foundation.

# ARCHAEOPARASITOLOGICAL FINDINGS IN ASIA: POSSIBLE EXAMPLES OF STOCKHOLM PARADIGM

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Nowadays, pandemic crises of emerging infectious diseases hit us repeatedly. Stockholm paradigm can be thought of as one of the academic ways to explain the change in disease patterns caused by environmental change. There have been our findings in archaeoparasitological studies that can infer Stockholm paradigm situations in Asian history. First, we reported the presence of trematode *Gymnophalloides seoi* from the coprolites of Joseon Dynasty mummies of Korea. In 20th century national surveys on *G. seoi*, the parasites were found in a part of southwestern coastal counties. However, in archaeoparasitological studies, we confirmed that *G. seoi* was prevalent in a much larger area than it is now. This clearly shows that the geographical distribution of *G. seoi* has changed significantly over hundreds of years; and the situation might be caused by changes in natural environment related to natural oysters, the intermediate host of *G. seoi*. In addition, we would like to introduce the pattern of changes in the parasite infection rate in the Joseon period mummies according to environmental changes. The results of Korean mummy studies can be related to Stockholm paradigm to a certain extent in that we prove the influence of environment on the occurrence of human parasitism in history.

**Keywords:** *Gymnophalloides seoi*, Joseon Dynasty mummies, Korea, environmental changes

**Funding agencies:** This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea Ministry of Education (2020R111A1A01073501).

# THE SECOND PLAGUE PANDEMIC IN THE BALTIC REGION – NEW EVIDENCE FROM ANCIENT DNA

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The Baltic region was repeatedly struck by plague, caused by the bacterium *Yersinia pestis*, during the so-called Second Pandemic (14<sup>th</sup>–18<sup>th</sup> centuries). After the initial wave, the Black Death (1346–1353), the Plague of the Great Northern War 1702-1714 is the most prominent outbreak in the Baltics, reportedly causing more deaths than any previous epidemic in some regions. Years of war, displacement and famines had weakened the local population and undermined state authorities, setting the stage for one of the last widespread plague epidemics in Europe. In the last two years, several papers presented a number of newly retrieved *Y. pestis* genomes from four Baltic sites, presenting evidence for repeated outbreaks of plague over several centuries. In our study, we aim to investigate the genetic history of the Second Pandemic in Estonia and neighboring regions, both by metagenomic screening of individuals on regular cemeteries and by targeted analysis of suspected plague burials. We present paleogenetic evidence for plague in six different urban and rural sites, spanning the 14<sup>th</sup>–18<sup>th</sup> centuries, linking the Baltic plague outbreaks to known *Y. pestis* lineages circulating in other parts of Europe at the same time and offering new insights into the phylogeography of the Second Pandemic. In addition, we contextualize our findings with the recently published plague genomes from the Baltic region which so far have not been presented comprehensively in synopsis.

**Keywords:** Estonia, Great Northern War, *Yersinia pestis*, paleogenetics

**Funding agencies:** ASTRA 2014-2020.4.01.16-0030, PRG243, PRG1027

# INDICATORS OF PHYSICAL ACTIVITY IN EARLY MEDIEVAL INDIVIDUALS BURIED WITH ARCHERY ARTIFACTS FROM VIENNA, AUSTRIA

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In the exploration of the meaning of weapons as grave goods indicators of physical activity were investigated on early medieval skeletons excavated in Vienna, Austria. This bioarchaeological pilot study investigated individuals who were buried with material evidence related to archery, such as bows, arrows, and quivers. These individuals (n=11) were analyzed for changes in muscle insertion sites, which could be related to the practice of archery. In order to control if differential burial practices could be based on actual differences in physical activity, the results were compared to individuals of similar ages from the same cemetery that were devoid of archery artifacts (n=15). Following the new Coimbra method, a comparison of five muscle insertion sites from the upper limbs across the two groups found significantly more enthesal change (EC) at the right subscapularis muscle insertion on the proximal humerus of the comparison group (p=.015). EC tended to occur more bilaterally in the comparison group (55%) than in the archer group (33%). At least half of the individuals that showed EC displayed a severe expression (archers: 50%, comparison: 70%). Interesting differences in asymmetry and expression of EC could be recognized within this population and those buried as archers potentially show less strain on the upper limbs. However, additional means of analysis are needed to support the findings of the small sample. These observations suggest that the grave goods do not necessarily indicate who practiced archery and these objects could carry additional meaning not limited to a warrior identity.

**Keywords:** Archery, Early Middle Ages, physical activity, enthesal change, funerary identity

**Funding agencies:** Funding was received from the City of Vienna (MA7) and the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement n° 856453 ERC-2019-SyG).

# A CRANIAL DEFECT FROM THE EARLIEST GRAVETTIAN AT THE CRO-MAGNON ROCK SHELTER (VEZÈRE VALLEY, DORDOGNE, SOUTHWEST FRANCE)

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Discovered over 150 years ago, the early Upper Paleolithic human remains from the Cro-Magnon Rock Shelter have an iconic status, but due to skeletal commingling after discovery, their bio-profiles remain incomplete and contentious. This contribution considers the cranium referred to as Cro-Magnon 2 in order to clarify the status of a defect on the frontal bone and to situate these remains among others of Pleistocene date. This presentation draws on the medical experiences of military physicians treating head injuries in the pre-antibiotic era in order to understand the form of the lesion, its differential diagnosis, and the behavioral sequelae of the injury with implications for mortuary treatment. This example from the distant past is located and thus helps to define obstacles and boundaries of interpretations of treatment and care accorded in the past.

**Keywords:** Early Upper Paleolithic, lesion, Cro-Magnon (Dordogne), mortuary treatment

# HYPEROSTOSIS FRONTALIS ON A SKULL FROM ANCIENT THEBES, EGYPT

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A case report of hyperostosis frontalis on a skull from an archaeological context is presented. Hyperostosis frontalis is the thickening of endocranial surface of the os frontale caused by the expansion of diploe. The etiology of the phenomenon is not defined; however it is related to age, hormonal disturbances or dietary factors. The exhibited skull originates from the archaeological excavation of the Department of Egyptology of Eötvös Loránd University, Hungary in Theban Tomb -400- (TT-400-), dated to New Kingdom (ca. 1550-1069 BC) and located in Cemetery of the Nobles on the West bank of Luxor, Egypt. The skull shows traits of hyperostosis frontalis with additional atypical characteristics. The thickness of the os frontale of the probably senile skull showing mainly male traits varies between considerable thickening and extreme, laminary thinning. The thickening of the frontal bone makes its inner surface uneven. The frontal bone also exhibits several protrusions (d=10-15 mm) on its outer surface. Additionally, numerous 2-3 mm pearl-shaped osteomas are visible on both the outer and inner surface of the os parietale, os temporale, os occipitale and along the lower margin of the orbita on the maxilla. The cranium also exhibits senile depression, or bilateral thinning of parietal bones. The skull was examined macroscopically during the on-site anthropological survey of TT-400-, and no histological analysis was performed. Due to the fragmentary state of the anthropological material no further skeletal element can be connected to the skull. Since the prevalence of hyperostosis frontalis in historical populations is reported to be low compared to recent samples, this case might be of paleopathological interest.

**Keywords:** Hyperostosis frontalis, hyperostosis cranii, biparietal depression, ancient Egypt

# INVESTIGATING THE PALEOPATHOLOGICAL PAST OF ROMAN GREECE: A PRELIMINARY STUDY OF INDIVIDUALS FROM THE ROMAN CEMETERY OF KLAVSI, EVRYTANIA, GREECE (2<sup>ND</sup>-4<sup>TH</sup> C. AD)

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Although scholarly attention on Roman Greece has increased in recent years, this time period is often neglected, whereas the health status of the individuals (paleopathology) remains severely understudied. The cemetery of Klavsi, located in Evrytania in northwestern central Greece, was excavated in 2017-2018 and constitutes the only Roman cemetery currently being investigated in the area; as such, data from this site bears potential for paleopathological analyses. In this preliminary study, the commingled human skeletal remains from 13 out of the 27 excavated graves at Klavsi were analyzed macroscopically. The aim of this study was to identify specific paleopathological categories, including dental diseases, pathological manifestations on the cranium, traumata, and non-specific infectious diseases. Differences in the health status based on biological sex were also investigated. The true prevalence of these paleopathological conditions was evaluated, whereas their various causative factors were discussed and contextualized. Isolated examples of conditions absent from or rarely observed in the Greek archaeological record, such as (benign) osteomata, osteomyelitis of the os coxae, and torticollis (wryneck), were identified as well. Despite the generally low frequencies, dental diseases, especially calculus, proved to be the most prevalent, while fractures were the type of lesion least often observed. Paleopathological differences between the sexes, although present in some cases, were not of statistical significance, similarly to other contemporaneous Greek cemeteries from other regions. Non-adults, although present in the sample, rarely exhibited pathological alterations with dental enamel hypoplasia being the most common condition. **Keywords:** Dental disease, anemia, trauma, non-specific infectious disease, Roman Greece

**Funding agencies:** This research project was primarily supported by the Department of Archaeology, Durham University, United Kingdom and Ustinov College through two grants awarded in May 2019.

# TUBERCULOSIS IN THE SUBADULT POPULATION OF MEDIEVAL AND EARLY MODERN KYIV

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Tuberculosis (TB), one of the most studied infectious diseases in paleopathology, is known for being a disease of poverty and social instability. Its prevalence increased in European populations during the medieval and post-medieval time periods to the urbanization processes accompanied by crowding, low hygienic standards, and intensifying mobility. Infants and children are characterized by a quick reaction to infections and lesion formation. Therefore, morbidity in this group is a sensitive indicator of a population's health. Kyiv, a large medieval city located at the crossroads of trade, was the center of Eastern Slavic World and Old Rus' State during the 10<sup>th</sup>–13<sup>th</sup> century AD. Unlike many other large European cities, Kyiv was relatively weakly industrialized in later time. This city remained a military and monastic centre during the period of the Liberation Wars and colonization of Ukraine by the Russian Empire in the 17<sup>th</sup>–18<sup>th</sup> century. This study aims to assess the factors impacting TB spread in Kyiv. The frequency of the skeletal manifestations of the disease was evaluated and compared for the two periods of the city's history. The sample includes 80 and 130 skeletons of subadults from the city and the monastic cemeteries dated to, respectively, the 10<sup>th</sup>–13<sup>th</sup> and 17<sup>th</sup>–18<sup>th</sup> centuries. Skeletons have been macroscopically studied for the lesions on the visceral surface of the ribs, in the vertebral bodies, and on the skulls' inner table and basis. Some of these results were confirmed by histological analysis conducted in collaboration with Professor M. Schultz. The study identified the reduction of the probable vestiges of TB in meninges from 18.2% of cases during the 10<sup>th</sup>–13<sup>th</sup> century to 4.8% of cases during the 17<sup>th</sup>–18<sup>th</sup> century. Simultaneously, the proportion of TB postcranial signs remained nearly the same or even increased. The occurrence of tuberculosis in Kyiv has been compared to its spread in the medieval and post-medieval European urban centers and rural communities.

**Keywords:** Tuberculosis, subadults, medieval Kyiv, Early Modern Ukraine

# ATYPICAL SCAPULAR TRAUMAS: DESCRIPTION, PREVALENCE AND POSSIBLE SCENARIOS

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Trauma analysis is an integral part of paleopathology, and forensic sciences; yet injuries to a scapula have received little attention in both fields. In 2020, during a rescue archaeological excavation, the remains of WW2 soldiers were unearthed in Lithuania: 718 individuals came from Zokniai, Šiauliai district, and 1009 individuals were found in Armalėnai, Šilutė district. Within the first set of individuals, healing linear scapular fractures and/or active new bone formation were recorded. For this particular analysis, bone preservation, number of injuries sustained, localization, size, and timing of injury (antemortem/healing/perimortem) were considered. All analyzed individuals were males, with the dominating age categories being those of young or middle-aged adults (60% of the total sample). While in a clinical context scapular fractures are quite rare, accounting only up to 1% of all lesions, over 7% of the Zokniai and Armalėnai individuals suffered linear fractures of the scapula. The localization and type of injury revealed some significant differences: The Zokniai individuals suffered linear fractures mainly around the center of the scapular body (78.1%), while the Armalėnai individuals experienced linear fractures on different parts of the scapula, as well as new bone formation visible only on the subscapular fossa (15.8%). The observed healing fractures do not follow the usual pattern that can be observed in the traumatology literature. No lesion like these was recorded in forensic cases, thus raising the questions as to what happened to the discussed individuals, and what kind of mechanism caused such injuries. The purpose of this presentation is to illustrate cases of these atypical lesions, and discuss their prevalence and possible cause.

**Keywords:** Scapula, trauma, fracture, active new bone formation, WW2, Lithuania

# A MULTIPROXY APPROACH TO RECONSTRUCTING WEANING AGE IN MEDIEVAL-POSTMEDIEVAL LUXEMBOURG CITY

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The main aim of this study is to test whether non-specific skeletal indicators of physiological stress as well as dental health can be used to reconstruct infant feeding practices, by correlating these indicators to stable isotope data from bone collagen. Therefore, a total of 27 children, from a late medieval-postmedieval cemetery in Luxembourg City, were analyzed. Samples for stable isotope analysis were taken at the center of the diaphysis and at the distal metaphysis of the femur or humerus of 15 children. During breastfeeding and after successful weaning completion, the differences between  $d^{15}\text{N}$  values in the diaphysis and metaphysis should be low as both areas of the bone would either reflect the  $d^{15}\text{N}$  values of breastfeeding or a solid food diet. However, during the weaning process, differences in  $d^{15}\text{N}$  values should be greater between the two bone areas as the midshaft still holds the much higher  $d^{15}\text{N}$  values provided by the consumption of breast milk and the distal metaphysis reflects the cessation of breast milk feeding. Dental status was recorded for 22 children and linear enamel hypoplasia (LEH) was recorded for the juvenile and adult individuals. Caries and dental attrition scores suggest a gradual introduction of solid foods into the diet at around 1-2 years. According to the isotope data and LEH frequency, the weaning process with breast milk cessation likely occurred around 2-3 years. These results suggest a similarity in weaning age, and therefore probably also in weaning practices to other contemporary European sites.

**Keywords:** Stable isotope analysis, dental health, weaning practices, Post-medieval, Luxembourg City

## DIFFERENTIAL DIAGNOSIS OF A CALCIFIED CYST FOUND IN AN 18TH CENTURY FEMALE BURIAL SITE AT ST. NICHOLAS CHURCH CEMETERY (LIBKOVICE, CZECHIA)

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In the St. Nicholas Church archaeological site (Libkovice, Czechia; the 18th century cemetery) a female skeleton with a stone object in the left iliac fossa was found. It was a cyst-like structure. The measures of it were 54 mm in length and 35 mm in maximum diameter. Within the object fetal bones (long bones, i.e. femur and two tibias, two scapulas, three ribs, vertebrae and other tiny bone fragments) were revealed. The methods used for the analysis were intended to describe the external and internal morphology of the object and its content: X-ray, CT imaging, SEM, histological staining and EDS. The EDS analysis revealed the presence of primarily oxygen, calcium and phosphorus in bone samples, and oxygen and silicon, in stone shell. The measurements of the femur (20.2 mm) and tibia (16 mm) shafts allowed to estimate the fetal age as the 15–18 week of pregnancy. During the differential diagnosis three most likely cases were taken into account: fetiform teratoma (FT), fetus-in-fetu (FIF) and lithopedion. FT was excluded due to the presence of long bones and their proportions, and due to the presence of an anatomically correct spine. Of the other two possible variants, fetus-in-fetu is more likely than lithopedion, due to the lack of a skull, better development of lower limbs, and low calcium content in the shell. The results do not allow to clearly answer the question which of these two cases is the object due to the insufficient number of similar discoveries in the excavation material.

**Keywords:** Paleopathology, fetus-in-fetu, lithopedion, fetiform teratoma, pregnancy

# MORBIDITY AND MEDICAL TREATMENT OF PARASITIC INFECTION IN ITALY DURING THE ROMAN PERIOD

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Intestinal parasitic infection causes high morbidity in modern populations. Roundworm and whipworm alone account for 1.9 million disability adjusted life years (DALYs) today. Widespread infections in the Roman period, prior to the discovery of modern antihelminthic medications, are predicted to have caused high morbidity as well. The aim of this study is to discuss the health impacts of parasite infections detected in Roman period Italy, and explore the Roman understanding of these infections and their approaches to treatment of parasites. Analysis of soil samples from four Roman sites in Italy (Lucus Feroniae, Oplontis, Vagnari, and Vacone) provide evidence for parasitic infection. Helminths including roundworm and whipworm were identified using microscopy, and *Giardia duodenalis* was detected using ELISA. Nine percent of pelvic soil samples were positive, providing an estimate of minimum prevalence. Medical texts written by Roman authors including high-status physicians and non-medical individuals, which give insights into popular medicine, were reviewed. They reveal a Roman understanding of the presence and transmission of some parasites, as well as a need to treat them. The morbidity caused by these infections is largely related to their impacts on nutrition, and would have disproportionately affected children causing long-term impacts on growth and intellectual development. Roman texts provide evidence for herbal remedies proposed by physicians and *patres familias* (heads of households responsible for health of the family) as treatment. Experimental studies show that some of these treatments could be effective, however use of these remedies likely did not significantly reduce disability caused by these parasites.

**Keywords:** Paleoparasitology, Roman Empire, history of medicine

# THE PALEOPATHOLOGICAL STUDY OF BOTH-BONE FOREARM FRACTURE AND MALUNION FROM THE WARRING STATES PERIOD OF CHINA (475-221 BCE)

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In this study, we report a rare case of both-bone forearm fracture and malunion in an individual from North Shenjiaqiao, Xi'an, China during the Warring States Period (475-221 BCE). Comparative measurements showed that the right radius was deformed, the morphology was consistent with both-bone forearm fracture. In this young adult, the right arm was abnormal in which the radius was bent at an angle of nearly 90°, the ulna was small and atrophic (approximately 6.5 cm), the bone marrow cavity closure, the humerus and hand bones were slender compared to the left side. It was concluded that fractures affected right forearm of the individual, the affected radius showed malunion resulted from fractures, while the ulna had non-union and atrophy. The right arm was handicapped, and this individual may have received care from family or kinship. This study was the first bioarchaeological case of forearm fracture with malunion in China. It will shed light on the paleopathological research involving fracture, and also provide us deeper understanding to the medical and life during the Warring States Period in China.

**Keywords:** Warring States Period, green bone fracture, angulated fracture, malunion, handicap

# RARE AND LETHAL: AN EXAMPLE OF THE MORPHOLOGICAL EXPRESSIVENESS OF A CONGENITAL DYSPLASIA ON THE WAY TO VANISHING

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Congenital skeletal disorders are a heterogeneous group of anomalies evident during gestation. They are expressed in the shape and growth of the bones during development due to a defective genetic background. We present an exceptional pathological condition on two perinates dated from the 18<sup>th</sup>-19<sup>th</sup> century, one from the convent of S. Domingos, Lisbon, and another from the Museum of Pathological Anatomy of the Faculty of Medicine, University of Coimbra, Portugal. Both skeletons show similar and exuberant alterations, especially a severe shortening and curvature of the long bones of the upper and lower limbs and an accentuated platyspondyly. The differential diagnosis guided us to consider thanatophoric dysplasia, achondrogenesis, and severe achondroplasia with developmental delay and acanthosis nigricans as the most plausible causes. Nowadays, with the follow-up of the pregnant woman and the advances in prenatal ultrasonographic examination and molecular genetic tests, congenital skeletal disorders are identified at an early gestational age. If they are considered lethal, the termination of pregnancy is advised. This scenario reminds us that some early developmental dysplasias, such as those manifested in fetal life, tend to vanish from their natural development and become rare in the clinical records. Cases preserved in museums of pathological anatomy assume a significant relevance to help the correct identification of paleopathology cases found in archaeological samples. Being these the last testimonies of a distant scientific and technological era.

**Keywords:** Skeletal dysplasia, rare diseases, non-adults, paleopathology, Portugal

# FIFTH-SIXTH CENTURY ARTIFICIAL CRANIAL DEFORMATION FROM THE CARPATHIAN BASIN

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Modification traditions of the human body have already appeared a long time before written records. Among these practices, the most common types of alteration include expansion, piercing, and stretching of soft tissues, such as tattooing. In contrast to the aforementioned soft tissue alterations, intentional modification forms of the skeleton, e.g., artificial cranial deformation (ACD), were less common. ACD was typically carried out during the early years of postnatal life, as the skull is most pliable at this time. With the hardening of the cranium, the artificial head form becomes permanent; therefore, it can also be observed in osteoarchaeological materials. Almost any archaeological period of the inhabited continents has yielded skeletal evidence for the practice of ACD. In the Carpathian Basin, the tradition of ACD reached its peak in the 5<sup>th</sup> century CE. However, until the middle of the 20<sup>th</sup> century CE, the number of unearthened osteoarchaeological series from this period has been scarce, preventing a thorough analysis of ACD practice. According to the actual state of research, the newly excavated, 5<sup>th</sup>–6<sup>th</sup>–century–CE cemetery of Tiszaug–Országúti bevágás, with its 195 graves, can be considered one of the biggest known sites from the Gepid era of the Carpathian Basin. In our presentation, we would like to contribute to improving our knowledge on the tradition of ACD in the Gepid era of the Carpathian Basin by presenting 25 individuals from the 5<sup>th</sup>–6<sup>th</sup>–century–CE cemetery of Tiszaug, who had artificially modified skulls based on macromorphological examinations.

**Keywords:** Trauma, body modification, artificial cranial deformation, Gepid era, Carpathian Basin

# OSTEOCHONDRITIS DISSECANS IN THE POPULATION OF SARILHOS GRANDES, PORTUGAL (14<sup>TH</sup>-19<sup>TH</sup> CENTURIES): IDENTIFICATION AND DIFFERENTIAL DIAGNOSIS

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Osteochondritis dissecans (OD) is an acquired pathological condition of the subchondral bone and underlying cartilage of the synovial joints associated with strenuous activity/trauma. The aims of this work are to study the prevalence of OD in a Portuguese sample, to understand if an agricultural population is more affected in the upper limbs, and to discuss the differential diagnosis of the lesions. A minimum number of 181 individuals (145 adults, 27 non-adults) including 21 individuals in primary position (9 non-adults, 12 adults; five males, five females, 11 undetermined) were excavated in the churchyard of Sarilhos Grandes (14<sup>th</sup>-19<sup>th</sup> centuries). All articular surfaces of the shoulder, elbow, wrist, hand, pelvic girdle, knee, ankle, and foot were macroscopically inspected. Eleven lesions (0.5%, 11/2310) typical or diagnostic of OD were identified in the elbow (2%, 3/151), pelvic girdle (1.2%, 3/257), shoulder (1%, 1/103), knee (1%, 3/304), and ankle (0.5%, 1/207) of adult individuals, similarly distributed in the upper (0.5%, 4/739) and lower (0.5%, 7/1330) limbs. Only one lesion (right elbow) was identified in an individual in primary position (1/11, 9.1%) and the remaining in commingled bones (10/11, 90.9%). Prevalence is lower than in other OD paleopathological studies. Although Sarilhos Grandes was an agricultural location, the upper and lower limbs were similarly affected by OD and the sandy and soft soil may have

contributed to the results. Five out of the eleven lesions may also be the result of osteonecrosis, osteomyelitis, tuberculosis, or Legg-Calvé-Perthes disease. The differential diagnosis is an essential factor when studying the disease.

**Keywords:** Synovial joints, articular surfaces, agriculture, paleopathology

**Funding agencies:** This study was supported by the Câmara Municipal do Montijo and the Research Centre for Anthropology and Health (CIAS).

# CONSEQUENCES OF SILVER ABUSE: PALEOPATHOLOGICAL ANALYSIS ON A CASE OF ARGYRIA FROM THE MORGAGNI MUSEUM OF ANATOMY (PADUA)

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The section of Pathology of the Morgagni Museum of Anatomy at the University of Padua (Italy) holds a unique specimen of argyria, an alteration consisting in a blue-greyish coloration of the skin caused by an excessive exposure to chemical compounds of the element silver. It is a stuffed head of a nineteenth century man who decided to refuse traditional medicine and cure himself with a caustic silver nitrate known as “infernal stone” every day for years. The prolonged intake of silver led him to develop a widespread and irreversible state of argyria. Recently, new paleopathological and historical studies were performed on the specimen to confirm his condition and the potential consequences of a continued ingestion of caustic silver. Histological and ultrastructural investigations were combined with morphological analysis, demonstrating a high presence of silver in the dermis and epidermis and highlighting other chemical elements, potentially related to the “infernal stone” composition. The rediscovery of this case allowed performing a comparison with present-day cases, potentially revealing a common feature: further prolonged intake may lead to a possible dependence on silver compounds due to the perceived benefits, although not real.

**Keywords:** Argyria, history of dermatology, drug response, clinical research, alternative medicine

# BIOCULTURAL ANALYSIS OF ANTE-MORTEM BONE FRACTURES IN THE LISBON IDENTIFIED SKELETAL COLLECTION (MUHNAC)

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A biocultural analysis was carried out on a sample of the Lisbon Collection of Identified Skeletons of the National Museum of Natural History and Science of the University of Lisbon (MUHNAC), dated from the 19<sup>th</sup> and 20<sup>th</sup> century, to understand how the cultural environment in which the Portuguese population lived impacted on the traumatic conditions and the well-being of the individuals, comparing physical remains with historical data. The skeletons of 410 individuals (187 females and 223 males) were studied macroscopically in almost their entirety to identify and describe ante mortem fractures, according to sociodemographic variables like sex, age or occupation and medical treatments. Ante-mortem fractures were present in 93 individuals (22.7%). Both sexes presented an almost equal percentage (male 24.2% and female, 20.9%) of fractures. Old individuals suffered a higher number of fractures (25.5%) compared to young ones (18.7%). Older males recorded more bone lesions (27.4%) than females (23.5%). However, no significant statistical differences were found. According to occupations, manual fractures appeared to be more prevalent (22.8%) than non-manual ones (22.6%). Also, females recorded mostly manual fractures (20.8%), related to domestic work. The biocultural approach has been proved useful to better understand the lifestyle of the ancient Portuguese population. Albeit limited historical data on professions, the studied individuals were employed in fatiguing tasks from a young age, often in unsafe and high-risk conditions. Medical care and treatment were accessible to treat also severe injuries without major complications, thus assuming a generally good quality of life, as per modern studies in living patients.

**Keywords:** Ante-mortem fractures, biocultural analysis, paleopathology, Lisbon Identified Skeletal Collection, population study

# GASTROINTESTINAL PARASITES AND CLIMATE CHANGE: FOCUS ON THE 4<sup>TH</sup> MILLENNIUM BC IN THE ALPINE ARC

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Climatic variation affects all living organisms, including pathogens and their way of transmission. As an example, among the meteorological parameters affecting the helminth development, environmental temperature and water-related variables influence the transmission rate of helminthiases. However, it remains difficult to distinguish these variations of environmental origin from the anthropogenic factors that also influence the development of parasites (as diet, social factors, etc.). The Neolithic period in Europe underwent strong climatic variations, among which a phase of well-marked deterioration during the 4th millennium BC in the Alpine arc. This phase is characterized by a significant decrease of the lake water levels. This climatic degradation also impacted the lake dwellers, particularly by encouraging modification and adaptation of their livelihoods, as well as population displacements. These changes in behavior towards climate-related food resources, or at least contemporaneous with climate variations, probably had an influence on the parasitic communities present in the lakeside settlement populations. What was the impact of climate change on the gastrointestinal parasite diversity during the Neolithic period? We will try to answer this question, on a specific area, the Alpine arc. Data from 23 lakeside sites spread over a total of 40 chronological phases have been collected. The aim of this study is to establish a synthesis of these data and to define if trends from a temporal point of view can be observed. In other words, how parasite assemblages vary in these sites, and what was the influence of both anthropogenic and climatic factors?

**Keywords:** Climate, Neolithic, Alpine arc, paleoparasitology

# REVELATIONS ON PAST EPIDEMICS THROUGH ANCIENT *TREPONEMA PALLIDUM* GENOMES

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Treponemal infections namely yaws, bejel and syphilis, are re-emerging diseases, representing a global threat to human health. Historically, syphilis is known from causing a devastating epidemic in Europe at the end of the 15<sup>th</sup> century. The origins and spread of treponemal diseases, however, remain unresolved, including the potential introduction of syphilis to Europe by Columbus’ expedition to America. Here, we analyze genetic data from wide selection of archaeological human remains from both Europe and Americas. We present several reconstructed ancient *Treponema pallidum* genomes retrieved by target enrichment and next-generation sequencing, that reflect a high diversity of strains related to both venereal syphilis and yaws, includ-

ing a formerly unknown form of treponemes phylogenetically basal to both bejel and yaws lineages. A molecular clock dating performed on ancient and modern genomes allows for a pre-Columbian origin of treponemal epidemics in the Old World, based on the estimates for the ancient European strains. Furthermore, a new high-coverage genome from Poland, providing an updated phylogeny and remarkable evolutionary analysis on the role of recombination in treponemes is studied in-depth among the ancient examples of the syphilis-causing strain. Our findings demonstrate a broad variety of treponemal diseases in Europe temporally close to New World contact and showcase that the treponematoses that are mostly restricted to the tropics and subtropics today, also existed widely in historical Europe. These results suggest a more complex pattern in the geographical distribution of early treponemal diseases than previously understood, and imply their possible endemic spread within the Old World.

**Keywords:** Ancient DNA, ancient pathogen genomics, historical syphilis, *Treponema pallidum*

# ALL GUNS BLAZING: THE GREAT NORTHERN WAR MASS GRAVES FROM TARTU, ESTONIA

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During road construction, previously unknown burial ground containing four mass graves, two double burials and eight single graves was discovered. The dead were buried just outside the town walls of Medieval and Early Modern Tartu. The location and several lead bullets found inside the skeletons indicate that the burials date to the Great Northern War (1700–1721). Further archaeological research confirmed that the dead had been soldiers from the siege of Tartu in 1704. The find is unique as it is the first and biggest battle grave from the long-lasting war that has been discovered from Estonia or from neighbouring countries. The skeletons belonged to Russians, who attacked the town and town defenders, consisting of local battalions and Swedish garrison. In three mass graves, dead had been simultaneously buried in the shallow graves and the topmost skeletons had been sagged into the bottom ones. The skeletons were intertwined without any order and from one common grave six Russian orthodox pendants were discovered. The analysis of the osseous material showed that the remains of at least 90 male individuals, between 17–50+ years of age, were buried in the excavated area. The demographic profile was similar to other war-related assemblages of the same region. Paleopathological analysis allowed to conclude that the battle was not fought face-to-face. The numerous gunshot and small cannon shot wounds identified from the remains suggest that the men had been killed from the distance.

**Keywords:** 18<sup>th</sup> century, The Great Northern War, mass graves, gunshot wounds, Tartu

# MULTIPLE MYELOMA: A REVIEW OF ARCHAEOLOGICAL SKELETONS WITH THE CONDITION IN ENGLAND FROM THE ROMAN PERIOD TO THE 19TH CENTURY

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Multiple myeloma or myelomatosis is a hematopoietic type of cancer. The lesions can be widespread in the marrow cavities throughout the skeleton and are multifocal in origin. Multiple myeloma lesions can show similarities to other diseases, like lytic metastatic cancer. Modern statistics indicate that multiple myeloma is a rare type of neoplasm, most commonly affecting older males (over 65 years old), with higher morbidity in older patients. There is no cure for the condition. Using a two-pronged approach, a literature review of both the archaeological evidence and current clinical data, this presentation aims to provide an overview of this neoplastic disease in archaeological skeletons from England dating from the Roman period to the 19<sup>th</sup> century. Possible cases of multiple myeloma in 13 skeletons (0.53%) from a total of 2,474 excavated individuals from 11 cemeteries across England have been published. Plain radiography and scanning electron microscopy were used to diagnose the lesions, however, in three individuals the diagnosis is uncertain. The individuals from Eccles and Stonar rural cemeteries in Kent, and from St. James Ipswich Suffolk, could also have been affected by lytic metastatic cancer. Most of the reported cases were from northern England and the majority of individuals are dated to the post-medieval period. All affected individuals were older than 35 years. Females were slightly more likely to be affected (0.68%) than males (0.57%), in contrast to current clinical data. It is possible that worsening pollution through time caused an increase in the rates of this malignant cancer.

**Keywords:** Cancer, myeloma, paleopathology

# CONGENITAL SYPHILIS IN MODERN FRANCE: A MULTIDISCIPLINARY STUDY

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This project focuses on children, as active agents contributing socially and economically to the functioning of ancient communities, in relation to past infectious diseases. We present the paleopathological and paleomicrobiological study of non-adult skeletons from four French archaeological collections: The “Carreau du Temple” (16<sup>th</sup>-18<sup>th</sup> centuries, Paris); The “Prêcheurs” (16<sup>th</sup>-17<sup>th</sup>, Aix-en-Provence) and “Crottes” (18<sup>th</sup>-19<sup>th</sup>, Marseille) cemeteries; and the “Capelette” (17<sup>th</sup>-18<sup>th</sup>, Marseille). Those individuals were selected according to their age (fetal age up to 10 years old), their bone state of preservation and the occurrence of pathological lesions. Our research was designed as a three-step study of those non-adult skeletal remains: paleopathological survey, molecular analyses, and search for historical data for contextual information. The macroscopic research was based on a systematic recording of the infectious pathological indicators. The paleomicrobiological methods (DNA extractions, PCR amplifications, Sanger sequencing and punctual Next-Generation Sequencing) were selected according to the relevant literature and followed the recommended authenticity criteria for ancient DNA analyses. Our macroscopic study was frequently hindered by the non-specific nature of the observed lesions. Nevertheless, the implementation of molecular tools allowed the identification of several - and previously unsuspected - cases of congenital syphilis among these children, highlighting the presence of this under-documented disease in these modern archaeological contexts. Such findings illustrate the benefits of integrating multidisciplinary data to improve our knowledge of child health and, to a broader extent, infectious diseases communities in the past.

**Keywords:** Childhood, infections, pathocenosis, paleomicrobiology, bioarchaeology

# INTRODUCTION TO “WORKSHOP: PALEOPATHOLOGY, DISABILITY AND CARE”

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The World Health Organization (WHO) estimates that over 1 billion people live with some form of disability, i.e. 15% of the current global population. This group generally has poorer health conditions and more easily experiences discrimination and marginalization. But if this is the current situation, what happened in the past? Dealing with consequences of disease or injury, often caused or exacerbated by environmental and/or social constraints, placed significant demands on individuals, their families and their communities. How can we identify the likely impacts of pathology? Who received care? Who provided care? How were short-term needs met and longer-term caregiving sustained? How were people with visible impairments treated? How successful was the care available, and what might difference in access to care (and type of care provided) suggest about contemporary norms and values? Addressing questions such as these will deepen our understanding of past disability and care, a goal now part of a new agenda in bioarchaeology. This presentation aims to widen the concept: ‘there are patients who cannot be cured, but there are no patients who cannot be cared for’. This will require new concepts as well as empirical foci, finding in the workshop the ideal venue to explore its limits.

**Keywords:** Paleopathology, disability, care, receiving care, providing care

# IDENTIFYING GEOGRAPHICAL AND TEMPORAL DIFFERENTIATIONS IN LATE BRONZE AGE/EARLY IRON AGE GREECE: A COMPARATIVE BIOARCHAEOLOGICAL APPROACH

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The Late Bronze Age (LBA) of the Eastern Mediterranean was a highly networked center of intercultural interaction. Reaching a zenith in the 14<sup>th</sup> to 13<sup>th</sup> centuries BC, social upheavals around 1200 BC led to a collapse of elite political and economic networks. Climate change, social revolts as well as mass migrations, have been proposed as a few of the possible causes of the collapse of the Mycenaean palatial system in Central and Southern Greece. In contrast, in Northern Greece political systems appear to have been largely uninterrupted, while in Crete at 1200 BC many defensible villages were established. The objectives of this paper are to examine a) the relation between specific social characteristics of LBA/ Early Iron Age (EIA) sites in Greece with lived reality and b) to explore potential temporal differentiations, during before and after the 1200 BC period. Skeletal assemblages spanning from Crete to Macedonia ranging from LBA to EIA were analyzed using stress and oral health indicators. Significant differentiations were found between communities of diverse social and environmental characteristics, confirming that crisis was not a uniform pattern in LBA/EIA Greece. For example, a number of northern communities of the wider context exhibited significantly higher rates of enamel hypoplasia, dental caries and calculus, compared with communities of Central-Southern Greece (e.g. enamel hypoplasia: 18.8% vs. 10.3%; caries: 12.2% vs. 10%; calculus: 15% vs. 11.1%). This in turn also highlights the great potentiality of paleopathology as a discipline to provide insights on significant archaeological and bioarchaeological questions about past lifeways.

**Keywords:** Crisis, health, lifestyle, prehistory

# AN UNUSUAL PATTERN OF TOOTH WEAR IN A MILITARY SAMPLE OF WW2

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Tooth wear is a multifactorial process that results from attrition (direct tooth-to-tooth contact) and abrasion (contact of teeth with other objects during mastication or use of teeth as tools in activities other than eating). Dental abrasion can result in various patterns such as grooves, notches, or chipping on the occlusal surfaces of the teeth. In 2020, during a rescue archaeological excavation in two Lithuanian sites called Armalėnai (Šilutė district) and Zokniai (Šiauliai district), the remains of 1727 soldiers of WW2 were uncovered. Upon standard paleo-odontological analysis, an unusual dental wear pattern (a V-shaped notch on the biting edge of the anterior teeth) was noticed. Prevalence of the defect differs between the sites: in Zokniai 37 out of 689 individuals (5.4%) expressed specific tooth wear, while in Šilutė only 17 out of 919 individuals (1.9%) were affected. All analyzed individuals were males, with the dominating age category being that of young and middle-aged adults. Despite the overall difference, the main patterns of unusual wear were similar in both samples. The majority of individuals (53.7%) had two teeth affected, and unilateral side defects of the corresponding upper and lower central incisors prevailed. Although right defects were more common, there was no statistical difference between the two sides of dentition. The purpose of this presentation is to discuss the possible causes of this unusual tooth wear with reference to clinical odontological studies, as well as cases from other military samples.

**Keywords:** Dental notch, chipping, soldiers, Lithuania

# EXPLORING DENTOALVEOLAR DISEASES AND DIETARY HABITS IN UPPER SOCIAL CLASSES FROM THE ITALIAN RENAISSANCE

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The relationship between dental diseases and dietary habits in ancient populations has been largely investigated in the anthropological literature, providing significant insights for the reconstruction of past lifestyles. While most researchers have investigated the pattern of dentoalveolar pathologies in lower social classes, only a few reports concerning oral health conditions in upper social classes can be traced. The purpose of this research is the examination of dental conditions and their interplay with dietary habits and foodways in elite members belonging to three high-class samples dated back to the Italian Renaissance. Dentoalveolar pathologies were investigated in the skeletal and mummified remains of the Guinigi family of Lucca (14th-17th centuries, Tuscany), the Medici family of Florence (16th-17th centuries, Tuscany), and the Saint Domenico series of Naples (16th-17th centuries, Campania), as representative of three important aristocratic classes of the Italian Renaissance and Early Modern Age. Human skeletal remains of 129 adult individuals and 1846 teeth were macroscopically examined for dentoalveolar diseases including caries, abscesses, antemortem tooth loss, periodontitis and calculus. The results indicate that the prevalence of all considered dentoalveolar diseases is very high, especially dental caries turns to be extraordinarily widespread, with a prevalence in the female subsample compared to the male counterpart. Males exhibit higher frequency for abscesses, while no appreciable differences have been observed in ante-mortem tooth loss. The Guinigi sample shows the highest frequencies of dentoalveolar diseases, particularly evident in the caries rate. These findings are probably related to changes in dietary habits during the transition from the medieval period to the Modern Age when cariogenic and refined foods were largely introduced and consumed in the diet.

**Keywords:** Dental pathology, diet, elites, Early Modern Age, Italy

# A CASE OF PARASITIC ZONOSIS FROM THE ANCIENT CITY OF LUNI (LIGURIA, ITALY)

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During archaeological excavations from the Imperial Age in the Roman colony of Luni (Liguria, Italy), some burials were found inside the ancient theatre that was employed as a funerary area in the Lombard period. In a grave, dated back to 640-700 BC, the skeleton of an adult-mature woman showed a large calcified spherical mass on the right side of the chest. It was located in correspondence of the 10th and 11th thoracic vertebrae, in the area occupied by the liver, lung, or kidney in the living. The mass consists of an empty calcified shell of 40-43 mm in diameter; the thin walls have irregular outer and inner surfaces and show little traces of vascularization. Radiological examination (RX and TC) shows no content inside the calcification, whereas electron and compositional microscopy surveys (SEM – EDS) reveal the nature of the shell. The section of its walls appears stratified and fibrous, and composed almost exclusively of phosphorus and calcium, suggesting that the calcification took place *in vivo*. Morphology and localization of the calcification direct the differential diagnosis to a hydatid cyst of *Echinococcus granulosus*, a zoonotic parasite. Dog is usually the definitive host, where the adult worms live in the intestines, but the larval form infects intermediate host, mainly sheep, pigs, cattle, and accidentally humans too, where the worms form cysts in various organs. The close cohabitation between sheep and dog increases the spread of the parasite and its presence at Luni confirms and improves the paleo-environmental and socio-economic reconstruction of the site. Indeed, Luni during the Lombard domination suffered an economic decline and it was partly abandoned; only small communities remained with agricultural and pastoral economies, in which evidently the cohabitation between man and animal promoted zoonotic parasites.

**Keywords:** Hydatid cyst, calcification, SEM, human remains, Middle Ages

# INTESTINAL PARASITES IN THE NEOLITHIC POPULATION WHO BUILT STONEHENGE (DURRINGTON WALLS, 2500 BCE)

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Durrington Walls was a large Neolithic settlement in Britain dating around 2500 BCE, located very close to Stonehenge and likely to be the campsite where its builders lived during its main stage of construction. Nineteen coprolites recovered from a midden and associated pits at Durrington Walls were analyzed for intestinal parasite eggs using digital light microscopy. Five (26%) contained helminth eggs, one with those of fish tapeworm (likely *Dibothriocephalus dendriticus*) and four with those of capillariid nematodes. Analyses of bile acid and sterol from these five coprolites show one to be of likely human origin and the other four to likely derive from dogs. The presence of fish tapeworm reveals that the Neolithic people who gathered to feast at Durrington Walls were at risk of infection from eating raw or undercooked freshwater fish. When the eggs of capillariids are found in the feces of humans or dogs it normally indicates that the internal organs (liver, lung or intestines) of animals with Capillariasis have been eaten, and eggs passed through the gut without causing disease. Their presence in multiple coprolites provides new evidence that internal organs of animals were consumed. These novel findings improve our understanding of both parasitic infection and dietary habits associated with this key Neolithic ceremonial site.

**Keywords:** Capillariasis, diet, fish tapeworm, Neolithic, paleoparasitology

# BABIES AND BOTTLES: NON-ADULT HEALTH AND FEEDING PRACTICES IN MEDIEVAL AND EARLY MODERN ESTONIA THROUGH STABLE ISOTOPE ANALYSIS

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Studying infant diet and stress through stable isotope analysis provides direct insights into the life of vulnerable population groups in the past. Little is known about childhood diet in medieval and early modern Livonia, and even less regarding the effects of the upheavals of the time on Livonian children. This study presents a comparative investigation of non-adult diet in urban/rural communities during the 13<sup>th</sup>-17<sup>th</sup> centuries AD, focusing on feeding practices and physiological stress. The impact of socio-economic circumstances on early childhood nutrition, affecting the physical development and overall survival of young children constitutes the core of this research. Bone collagen from 176 individuals between the fetal and the 7-15 age categories from four urban/rural South-Estonian cemeteries was cross-sectionally analyzed via EA-IRMS for  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ . Results indicate that South-Estonian children had a staple terrestrial  $\text{C}_3$  diet integrated with consistent amounts of animal proteins. Significant divergences were observed between urban and rural sites and among rural subgroups. Breastfeeding was likely practiced for 1-2 years, introducing supplementary foods at around 1 year of age. The weaning process was probably concluded around the age of 3. The isotopic values of older children are comparable to the adults, indicating their diets became similar after weaning, when they started working and obtained a more mature social status. This study provides the first data regarding infant feeding practices in medieval and early modern Livonia. Furthermore, the large number of perinates allowed exploring the impact of maternal physiological stress, malnutrition and metabolic disease on their isotopic values.

**Keywords:** Stable isotope analysis, non-adult bioarchaeology, Livonia, medieval and early modern Baltics, dietary reconstruction

# PREHISTORIC HOOKWORM IN THE AMERICAS: CLIMATE-BASED POTENTIAL TIMES OF ENTRY AND REQUIRED MIGRATION SPEEDS

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The thoroughly documented prehistoric presence of the anthropophilic hookworm in the Americas raises interesting questions about early human migrations into the continent. Particularly puzzling is how an infection by a parasite that requires relatively warm environmental conditions for transmission - a conservative estimate is  $> \sim 8^{\circ} \text{C}$  - persisted in a population migrating across the high-latitude region between NE Asia and NW North America, the generally accepted route taken by first migrants and an area that is free of the parasite in the present day. Here we employ state-of-the-art climate models and paleodata to reconstruct environmental conditions in different areas and periods pertinent to the migration process. These reconstructions, in conjunction with information about hookworm biology, are used to generate estimates of required human migration speeds and optimal periods for the entrance of the parasite into the Americas. This project updates earlier similar efforts and takes into account advances in paleoclimate data and modeling and in our understanding of the migration processes, particularly the recent evidence supporting a pre-Last Glacial Maximum human presence in North America and the genome-based migration model that proposes the, prior to dispersal into the Americas, migrants remained genetically separated for at least many centuries from other Asian populations. Another innovation is the inclusion of the dog hookworm, whose eggs have been found in prehistoric dog coprolites in the Americas. Current understanding is that domesticated dogs accompanied early migrants from Asia to the Americas, so that the same type of analysis can be applied to both parasites. Results will generate constraints to current peopling of the Americas theories; increase our understanding of human migrations in general as well as hookworm biogeography.

**Keywords:** Hookworm, Americas, paleodata

# HUMAN OSTEOARCHAEOLOGY EDUCATIONAL ACTIVITIES: APPROACHING DIFFERENT AUDIENCES OUTSIDE THE MUSEUM

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This presentation will outline a series of educational activities organized at the Science and Technology in Archaeology and Culture Research Center of the Cyprus Institute for the communication of human osteoarchaeology to a wide audience of school children and members of the public with disabilities. The aim of all activities was to highlight the importance of the human skeleton as a key source of information regarding life in the past. The nature of the audience coupled with the sensitive nature of the archaeological material presented, made us prioritize the combined use of 3d scans and 3d printed bone models, along with more traditional means, such as posters, video presentations, and print-out forms. Our proposed activities for school children have been organized in an open access guide of 'Archaeological Science Classroom Activities' so that their implementation is generalized by teachers and parents. For adults with disabilities, the activities took two broad forms: 1) experiential workshops on the human past for students of the School for the Blind, whereby the attendees listened to a narrative about the human past, as revealed through human bones, material culture, and plants, and emphasis was placed on tactile tasks involving raw materials, bone casts and modern plants, and 2) a hands-on activity that bridged paleopathology, functional anatomy and 3d printing and resulted in the production of a prosthetic hand, which is to be donated. In all activities emphasis was placed in viewing the human skeleton as an indispensable part of the archaeological record, organically linked with the material culture and the natural environment.

**Keywords:** Osteoarchaeology, classroom activities, experiential workshop, 3d printing

# PALEOIMAGING OF A MIDDLE PALEOLITHIC CASE OF LABYRINTHITIS OSSIFICANS

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The remains of Dar-Es-Soltane II H5 were discovered in 1975 near the city of Rabat in Morocco during excavations directed by A. Debenath. They were associated with a lithic techno-complex called Aterian (Northern African Middle Stone Age) and could be dated around 100 ka. The remains of Dar-es-Soltane II H5 consist of an almost complete frontal and a large portion of the left side of the cranium including the face, temporal bone, part of the parietal bone and greater wing of the sphenoid. The bony labyrinth anatomy was investigated on existing micro-CT data acquired by the MPI-EVA. The observation of micro-CT sections revealed a partial filling of the semi-circular canals that raises question about its origin. This filling could either be formed by sediment deposited postmortem or alternatively represents the ossification of the membranous labyrinth during the individual's lifetime. The latter would indicate a pathological condition. A careful examination of the micro-CT sections shows that the elements present in the semicircular canals were denser than the sediments observed in other regions and cavities of the temporal bone. It is also possible to observe a significant osteocondensation around the entire bony labyrinth. The current evidence therefore suggests a pathological origin of this condition with partial ossification of the membranous labyrinth, and the differential diagnosis indicates a possible case of labyrinthitis ossificans in its early stages. This pathological condition usually results from a local/regional infection and is responsible for a permanent hearing loss and impacts perception of equilibrium, causing dizziness and vertigo.

**Keywords:** Bony labyrinth, temporal bone, microCT-scan, labyrinthitis ossificans, hearing loss

## TRACES OF AMPUTATIONS AND AUTOPSIES IN WWI PRISONERS-OF-WAR FROM ERFURT (GERMANY)

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Prior to a school construction, burials from a former WWI military cemetery in Erfurt had to be exhumed. They mainly originate from Russian prisoners-of-war (POW) who died in a hospital belonging to the POW camp Erfurt Johannisplatz (1916-1919). Commonly, the skeletal remains show traces of autopsies and surgical interventions probably connected to severe, life-threatening conditions. Until now, it was unknown, that such practices were conducted in larger scale in POW in WWI imperial Germany. The skeletal remains of about 36 individuals were investigated. They originate from single burials, as well as from commingled contexts. Macroscopic methods, as well as reflected-light microscopy, endoscopy, and radiology were employed. With regard to the intended reburial and/or repatriation, no invasive methods were conducted. At least six individuals show traces of autopsies: typical horizontal craniotomies, and in two cases a vertical opening of the thorax. In two cases, the autopsies can be associated with a probable TBC infection, which manifested as pathological changes on the ribs. Possibly, also in the other individuals, the observed autopsies had been performed for similar, medical reasons. Most of the POW have reportedly died during repeated outbreaks of typhoid and/or spotted fever. However, other reasons, such as training for military surgical personnel, or even craniological studies, cannot be excluded. In one individual, an amputation in a highly inflamed, fractured femur was performed. Apparently, it did not save the patient's life: both leg and body were found in same grave, with no visible traces of healing on the amputated femur.

**Keywords:** Craniotomy, thorax opening, tuberculosis, amputation, military cemetery

## UPPER NEOLITHIC MINERS IN NORTHERN THURINGIA (GERMANY)

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Due to the geological conditions created by the ice ages, Central Germany is poor on easily accessible silex sources, except for Baltic flintstone. One of such sources is located close to the town of Artern in northern Thuringia, in the foreland of the Harz mountains. During a large-scale excavation project, 530 features connected to silex mining in an area of about 6500 m<sup>2</sup> were identified, and 89 of them, which were endangered by modern constructions, were excavated. However, the original mining area was probably much larger. The oldest pits were flat and shallow, as the silex was still abundant close to the surface. From the upper and late Neolithic on, miners had to dig shafts and tunnels up to 6 meters deep. In one of these shafts, 892 silex artifacts were found, representing remains of a chipping floor. A total of 16 skeletons was excavated, the oldest from the Baalberg culture (middle 4<sup>th</sup> mill. BCE), up to the Corded Ware culture (middle 3<sup>rd</sup> millennium BCE). Most of them date between 3700 and 3200 cal BCE. At least eleven individuals were connected to the observed mining activities. They were found in the shafts, sometimes even on their very bottom, or had mining equipment on them. The investigation included macroscopy, reflected-light microscopy, endoscopy, and radiology. In one shaft, a male and a female skeleton were found, the male showing a probable perimortem trauma of the skull. Further injuries, such as fractures, and enthesal changes might be connected to the hard work underground.

**Keywords:** Central Germany, silex miners, skeletal trauma patterns, upper and late Neolithic, work underground

# POSSIBLE TRACES OF METABOLIC AND INFECTIOUS DISEASES IN COLONIAL SKULLS FROM THE FORMER DUTCH EAST INDIES (19TH CENTURY)

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During a provenience research project funded by the German Lost Art Foundation, an anthropological and paleopathological investigation of 33 human skulls from the natural historical collection of the Gotha Castle Foundation in Central Germany was performed. The skulls originate from the former colony of the Dutch East Indies, nowadays Indonesia, and were incorporated into the collection between 1862 and 1880. Written sources including remarks and labels on the skulls indicate that the majority originates from military or prison hospitals in Batavia. Others were those of local men who took part in a war against the colonial government and were reportedly executed. Military, as well as medical officers, brought the skulls to Europe. Anthropological and paleopathological investigation was carried out by non-invasive, morphological methods, including reflected-light microscopy, and endoscopy. Most skulls originate from young adult males, only one from a female. In five individuals, possible traces of scurvy were detected. These include new bone formations in and around the alveoli, in areas of muscle attachment marks, and in other typical locations, such as the external surface of the greater wings of the sphenoid. From the current paleopathological record, such traces are mainly known from infants. In six individuals, possible traces of anemic marrow expansion were observed. In further six individuals, granular impressions, as well as distinct digital impressions were detected, representing features often associated with tuberculous meningitis. Against the background of the documented historical context, these findings probably indicate persistent malnutrition and harsh living conditions of the individuals.

**Keywords:** Anemia, Gotha skull collection, military or prison hospital, scurvy, tuberculous meningitis

## THE BENEDICTINE MONASTERY OF ST. MICHAEL IN PULA (ISTRIA, CROATIA): AN INSPIRATION FOR DANTE'S INFERNO?

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The paper presents the results of paleopathological analysis of human skeletal remains recovered from the medieval cemetery around the Benedictine monastery of St. Michael in Pula. According to some authors, Dante Alighieri used this cemetery as an inspiration for his poem *Inferno* due to terrible conditions of the burials and overcrowding of corpses. The preventive excavations revealed 115 burials radiocarbon dated between the 10<sup>th</sup> and the 13<sup>th</sup> century. It seems that the graves were constructed in a hurry and filled very quickly without much concern for the deceased. Very few of the analyzed burials contained grave-goods, and some (about 10%) were covered with a thick layer of quicklime. Most burials (n=89) contained multiple skeletons ranging from three to 38 per burial (over 1200 individuals in total). The majority of the studied remains belong to adult males, probably Benedictine monks. However, the skeletons of females (ca. 200) and children under the age of 18 (ca. 260) were also recovered. Over 30 adults had ante- and peri-mortem injuries, while other diseases such as tuberculosis, rickets and scurvy affected adults and subadults. Indicators of subadult physiological stress were recorded in almost half of the skeletons. The results indicate extremely poor health conditions in this community which is in accordance with written historic sources. Namely, these sources speak about violent events such as several sieges of the town, but also of numerous outbreaks of plague, malaria, typhoid and smallpox that decimated the population of Pula during the medieval period.

**Keywords:** Cemetery, fracture, infectious diseases, Middle Ages

# THERE WAS OR THERE WASN'T A BEAR CULT - A CASE STUDY OF *URSUS ARCTOS ARCTOS* (LINNAEUS, 1758) TOOTH PALEOPATHOLOGY FROM THE PLEISTOCENE OF POLAND (SILESIA, SE POLAND)

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The analyzed specimen was found in the 1930s by Zotz, in Wschodnia cave (German name Hellmichhöhle, now W Sudeten Mts, Poland). Currently, it is housed in the Archaeological Museum of Wrocław. It is a well preserved splanchnocranium with teeth of an adult Eurasian brown bear. Integral part of the skull is also an intact mandible. Several postcranial skeletal bones were also found for this specimen, including one rib with a human-drilled hole. For the above-mentioned specimen, three C14 datings were made using the AMS method. All three dates gave similar results, allowing the age of the find (after calibration) to be estimated at 14.8-13.8 KY BC, i.e. the Bølling phase of relatively older Dryas. Taxonomic assignment, based on the morphometrical analysis, was confirmed by DNA analysis. It represents subclade 1b, recently identified in Carpathian Mts. The degree of wear of his tooth crowns, especially his incisors and canines, is remarkable, which is completely inadequate to the wear of the remaining teeth and to the individual's age. German researchers suggested that the procedure was performed by a human for ritual purposes. However, the anthropological nature of this find was questioned by Polish researchers, who said that the process was natural and that the abrasion of the front teeth was the result of a malocclusion. Our analyses confirm the earlier assumptions of German scientists that the pathologies visible on the teeth are the result of anthropogenic effects, which was the aim of our research. It is also indirect evidence of the presence of *Homo sapiens* in the Late Pleistocene of the Sudeten areas of Poland.

**Keywords:** Bear, animal, paleopathology, Poland

# PATHOLOGY, TRAUMA, DIET AND LIVED EXPERIENCE AT PLINKAIGALIS, LITHUANIA

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Little is known about the Migration period in Lithuania's history despite its centrality to major political and cultural changes regionally and throughout Europe and Asia. This research is part of an ongoing dissertation project that is focused on the reconstruction of lived experiences of 254 individuals interred in the Migration period (5th-7th century CE) cemetery in Plinkaigalis, Lithuania using isotopic analysis, statistics, and GIS. This discussion will focus on preliminary data with an emphasis on diet, trauma, pathology and mobility, which are major components of lived experience, as defined by the researcher. Lived experience is assessed based on carbon, nitrogen, and oxygen stable isotopes, graphical analysis and osteological analysis of 49 individuals. Isotopic methodology includes analysis of human teeth (first molars) and bone (femoral) for carbon, nitrogen, and oxygen to evaluate diet, assess stress associated with various metabolic processes (protein stress, water stress, illness, and gauge mobility from early to later life). Preliminary findings based on isotopic, statistical and geospatial analysis are presented within the framework of Social Identity theory. Initial findings suggest a homogeneous C3 diet, movement from north to south, and some differentiation between sex, age and status groups based on burial location and trauma presence.

**Keywords:** Stable isotopes, GIS, diet, pathology, trauma

**Funding agencies:** Support of this research was provided by the Rust Family Foundation and the Association for the Advancement of Baltic Studies.

# INJURY PATTERNS IN AN AVAR PERIOD CEMETERY FROM LEOBERSDORF, AUSTRIA

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The skeletons from the cemetery of Leobersdorf, Austria are re-analyzed within the international ERC project HistoGenes. The goal is to investigate the biohistorical background of several communities from the Early Middle Ages (7<sup>th</sup> to the 9<sup>th</sup> century AD) in Eastern Central Europe by means of analyses of cemeteries from the Carpathian Basin from historical, genetic, anthropological, and archaeological perspectives. In the anthropological part, we assess demographic, traumatic and disease patterns to examine the living conditions of the communities. In our pilot study on Leobersdorf we analyzed 164 skeletons in detail. The focus is on physical burdens in individuals from the age of 14 years onwards (56 males and 60 females, anthropologically and genetically sexed), especially on fracture and trauma patterns. The highest percentage of healed fractures is seen in ribs of males (c. 21 %), and females (c. 13 %), and left upper limbs of males (13 %). One male and one female are affected from a minor skull trauma, while one male suffered from a severe healed facial fracture and involvement of the shoulder. We found no case of decapitation, and no cases of lower limb fractures. Only one male shows a probable perimortem penetrating injury at the left scapula. In general, fracture frequencies are low, especially among females and there are only few indicators for interpersonal violence. The severe facial fracture might rather be related to a horse kick incident as well. Moreover, most of the fractures are well-healed, pointing to a good support network in the community.

**Keywords:** Fracture, trauma, Avar period skeletons, Austria

**Funding agencies:** This project has received funding the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement n° 856453 ERC-2019-SyG).

# REVIEWING AND ASSOCIATING STABLE ISOTOPE ANALYSES, CONTEXTUAL CULTURAL DATA, ANIMAL PROTEIN CONSUMPTION AND THE MOST PREVALENT PATHOLOGICAL CONDITIONS OF PREHISTORIC AND HISTORIC GREECE

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Stable carbon and nitrogen isotope analyses of human bone collagen have been applied to prehistoric and historic Greek populations since the 1990s to over 1,000 samples. The results enabled, apart from the detailed dietary reconstruction, its correlation with contextual and paleopathological data and the observation of their fluctuation through the different cultural periods. Specifically, (domesticated, wild or marine) animal protein availability, accessibility and adequacy in nutrition seems to be closely associated with uninterrupted childhood development, dental health and the general biological wellbeing of the archaeological populations. This integrating work shows: a) a pattern of association of the isotopically documented animal protein consumption with major sociocultural and economic shifts; namely the periods exhibiting elevated nitrogen values ( $\delta^{15}\text{N}$ ), which indicate higher animal protein incorporation into the diet, coincide with periods of economic and cultural growth and reversely, the periods with the lowest points of isotopic nitrogen values, and consequently diets deficient in animal protein, are related with transitional periods of population movements, poverty and conflict, b) the isotopically implied inadequacy of animal protein in nutrition, in a similar pattern, can be associated with higher prevalence of anemic cranial porosities, poor dental health and suboptimal living conditions in the same groups, in synergy with other concomitant factors, and c) intra-site, occupational, social, and gender differences are also reflected in the disease prevalence and in the differential incorporation of animal protein in the diet, with farming communities, lower status individuals and females exhibiting less animal protein accessibility and more nutritional and developmental biological stresses.

**Keywords:** stable isotopes, animal-protein diet, anemia, Greece

# COMPARISON OF DENTAL STATUS PARAMETERS AND DEGENERATIVE ALTERATIONS OF THE TEMPOROMANDIBULAR JOINT IN SKELETAL FINDS FROM A GERMAN MEDIEVAL CEMETERY

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Osteoarthritis is a degenerative joint disease commonly identified in archaeological human remains. This condition primarily affects stress-bearing joints, which include the temporomandibular joints. Comparing dental status and degenerative alterations of the temporomandibular joints of the same individuals is crucial for understanding the role of the former in increasing predisposition to temporomandibular osteoarthritis. A comparative study between dental status parameters and the extent of temporomandibular osteoarthritis was conducted on selected individuals from the medieval cemetery of Dalheim in Germany. For each individual, the number of surviving molars and premolars and their associated occlusal macrowear were compared with both the radiodensity of the mandibular condylar processes and the thickness of the roof of the temporal bone's glenoid fossa. Indicative visual parameters indicating osteoarthritis (e.g., flattening of the condyle, osteophytes) were also documented. All radiodensity and thickness measurements were performed on computed tomography data using multiplanar reconstructions for sagittal and coronal alignments. By comparing the radiodensity of the condyles with dental wear, it was also possible to determine whether subjects had unilateral or bilateral temporomandibular joint degeneration.

**Keywords:** Osteoarthritis, temporomandibular joint, tooth wear, computed tomography, Middle Ages

# WUTHERING HEIGHTS: PALEOPATHOLOGICAL APPROACHES TO CLIMATE CHANGE, LIMITS AND POTENTIALS

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This presentation takes stock of the present state of paleopathological studies on climate change and crisis in the past, in order to outline trends and potentials, as well as structural pitfalls of this research avenue. The study of how climatic fluctuations impacted human health is receiving increasing attention in paleopathological venues around the world. The growing number of projects, publications and meetings on this topic attests that paleopathology is a dynamic discipline, focused on the past but outstandingly receptive to topics that dominate major public fora today. Yet, the literature survey presented here points out three major limits affecting paleopathological research on climate change and human health: The interpretation of multidisciplinary data bridging pathological changes of the bones and change in climatic conditions is often limited to stereotypical interpretations; The reconstruction of global and local health trends in response to climatic changes in the past is affected by colonial criteria of access and dissemination of the data; A large number of paleopathological research experiences on climate change and crisis are unable to reach out to the larger public and to assume a proactive role against the challenges raised by the climate crisis today. The results show that paleopathological studies on climate change and health cannot achieve their full potential without focussing on the work of local researchers and their effect on local communities. Furthermore, media experts must be integrated in the reformulation of data dissemination strategies, if paleopathologists are to engage in a topic with such a global impact.

**Keywords:** Climate, change, health, outreach

# CENTENARY OF THE BIRTH OF ARTHUR AUFDERHEIDE (1922-2022)

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This year marks the century since the birth of prominent paleopathologist and mummy specialist Dr Arthur Aufderheide, whose role was vital in the development of modern mummy science. Aufderheide was a medical doctor who in the 1970s started pursuing a career in the study of ancient disease. An author of four books and over 100 scientific papers, he also contributed to the establishment of the World Committee of Mummy Studies. Hence, this round table will be dedicated to his figure, to his numerous achievements, and to his legacy. Scholars from different continents will gather and commemorate Art and his wife Mary, his contribution to paleoepidemiology, as well as his mentorship towards early career researchers.

**Keywords:** Mummies, Aufderheide, Mummy Congress

## X-RAYS AND LIFEWAYS: A NON-DESTRUCTIVE METHOD TO STUDY MASTOIDITIS

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Mastoiditis is a common childhood infection and a complication of middle ear infection in adults. The complications of mastoiditis range from behavioral, disabling, to fatal. An episode of mastoiditis as a child can permanently stunt the development of the mastoid air cells (residual childhood mastoiditis or RCM). This puts an individual at risk of developing future episodes of mastoiditis. Despite this, mastoiditis is understudied archaeologically, and its current study requires destructive methods or access to large imaging equipment. This project developed and tested a non-destructive, accessible, and clinically grounded method of imaging the mastoid processes, using a hand-held X-ray system, and diagnosing mastoiditis. An Anglo-Saxon/Saxo-Norman (Black Gate; n=208) and Industrial Period (Coronation Street; n=88) population from England's North-East were studied. The rate of mastoiditis was compared to the rate of maxillary sinusitis (MS) and lower respiratory infection (LRI). This was the first systematic study of mastoiditis and MS in English populations from these periods. Differences in infection rates amongst individuals from different age groups, grave types, and biological sexes reflected different exposures to risk factors. In general, the Coronation Street population appeared frailer than the Black Gate population, likely reflecting the ubiquity and severity of some risk factors and the embodied effects of classism and sexism. In sum, mastoiditis was found to reflect individual health more accurately than MS and LRI, likely because mastoiditis can affect the skeleton when subclinical unlike MS and LRI.

**Keywords:** Mastoiditis, paleoradiology, paleoimaging, respiratory-related disease, maxillary sinusitis, lower respiratory infection, life history, method, Anglo-Saxon, Industrial, England

# CORTISOL IN DECIDUOUS TOOTH TISSUES: A POTENTIAL METRIC FOR MATERNAL STRESS?

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Cortisol is a glucocorticoid hormone produced by the Hypothalamic-Pituitary-Adrenal (HPA) Axis on a circadian rhythm and in response to stressors. Studies of stress in modern human and non-human populations regularly assess cortisol concentrations in saliva, blood, and hair as a measure of stress exposure and experience. Recently, cortisol concentrations have been obtained from modern and archaeological permanent teeth. In this pilot study, human deciduous teeth from modern and archaeological contexts were assessed for cortisol concentrations. Cortisol is thought to be incorporated into tooth structures during the development of the tissue. As such, cortisol concentrations present in deciduous dentine and enamel would reflect exposure during the intrauterine period. If present and detectable, cortisol concentrations from deciduous dental tissues could potentially act as an indicator of fetal and maternal stress exposure. Dentine and enamel from five modern and 10 archaeological deciduous teeth were analyzed for cortisol concentrations via Enzyme-linked Immunosorbent Assay (ELISA). Detectable concentrations of cortisol were identified in both modern and archaeological deciduous tooth structures. However, not every sample generated cortisol values that were detectable using the current methodology. Comparisons between modern and archaeological teeth did not reveal any consistent patterns in cortisol concentrations. This study represents the first known analysis of cortisol from deciduous dental tissues. However, current methods require further testing and analysis before dental cortisol concentrations can be used as a stress indicator.

**Keywords:** Glucocorticoid hormones, stress, dentine, enamel, fetus

**Funding agencies:** Postdoc2MUNI CZ.02.2.69/0.0/0.0/18\_053/0016952; Wenner-Gren Post PhD Grant 1248655869

# INFECTION, TRAUMA, OR SPONDYLOARTHROPATHY? CHALLENGES IN DIFFERENTIAL DIAGNOSIS IN A ‘SOLDIER’ FROM EXCAVATIONS AT THE JIČÍN OBSERVATORY, CZECH REPUBLIC

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Rescue excavations at the Center of Natural Sciences and Observatory of Jičín Observatory, Czech Republic revealed a mass grave dated to the 18<sup>th</sup>-19<sup>th</sup> centuries. The presence of zinc buttons typically associated with Austrian and Prussian military uniforms could suggest that this grave was related to a military context. Analyses of the skeletons revealed the remains of a minimum of 47 articulated individuals from the mass grave. Most individuals were young adults and were identified as ‘male’ or ‘probable male’. One individual, a mature adult male displayed extensive new bone formation on multiple vertebrae and ribs. Using macroscopic analyses, differential diagnosis of the condition was attempted to clarify if these lesions resulted from infectious, traumatic or other etiologies. The presence of infection within military contexts is well-documented historically, but relatively few paleopathological studies have reported signs of chronic infection in the skeletons of military personnel. Potential differential diagnoses included tuberculosis, spondylodiscitis, diffuse idiopathic skeletal hyperostosis (DISH), ankylosing spondylitis (AS), and traumatic injury to the thorax. No visible signs of trauma or injury were observed, and the bilateral presence of the lesions suggested a more systemic condition. Typical or diagnostic signs of tuberculosis were absent. Due to difficulties in diagnosing spondyloarthropathies in their early stages, it was not possible to provide a definitive differential diagnosis. Several conditions including early stages of DISH, AS and non-specific infectious agents remain potential causes of the observed lesions. This case study highlights the challenges to investigations of infection and other health stressors in military contexts.

**Keywords:** Mass grave, tuberculosis, spondylodiscitis, diffuse idiopathic skeletal hyperostosis, ankylosing spondylitis

**Funding agencies:** Postdoc2MUNI CZ.02.2.69/0.0/0.0/18\_053/0016952

# ADDRESSING AND CONTRASTING APPLICATIONS OF THE STOCKHOLM PARADIGM AND ONE PALEOPATHOLOGY

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Two new theoretical perspectives were introduced during the last four years that are relevant to archaeological parasitology. The Stockholm Paradigm presents an interpretive structure of interwoven geographic, adaptive, expansion factors with new understanding of the adaptive capabilities of parasites. The Paradigm provides a way to reconstruct range expansion and emergence of parasite infection. ONE Paleopathology developed within the study of ancient diseases from a holistic perspective, wherein (nonhuman) animal paleopathology and human paleopathology are integrated. The ONE Paleopathology perspective represents transdisciplinary thinking about health and disease. These two perspectives are illustrated in this presentation. Through the Stockholm Paradigm, the evolution of African and American trypanosomiasis is shown starting with the fragmentation of Gondwana to the joining of the Americas and finally the entry of humans into areas of endemic natural infection cycles. The ONE Paleopathology approach is illustrated by the study of coprolites from a cave near Rio Zape, Durango, Mexico. There, five dog-specific parasites, three human-specific parasites and five parasites that infect both humans and dogs were found. Ancillary molecular work indicates that dogs and humans experienced cross-fecal contamination. Therefore, for this site, dog-human association reveals the health consequences of close association between humans and companion animals.

**Keywords:** ONE Paleopathology, Stockholm Paradigm, parasite evolution, companion animals and human health

# INFANT PALEOPATHOLOGY AND BIOCHEMICAL ANALYSIS: A COMBINED APPROACH TO THE STUDY OF METABOLIC DISEASE IN PRE-ROMAN ITALY

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This research presents a case study of seven out of 25 non-adult individuals, from a larger paleopathological and isotopic investigation of the Etruscan Orientalizing (720-580 BC) skeletal sample from the eastern necropolis of Pontecagnano - Chiancone II property (southern Italy). The osteological analysis of these infants identified pathological lesions including diffuse micro-porosities and periosteal new bone formation on the skull and long bones. The distribution and morphology of these abnormalities allowed us to conclude that these non-adults probably suffered from scurvy (vitamin C deficiency). The dietary profile of these individuals will be investigated by incremental dentine sampling for stable carbon and nitrogen isotope analysis and stable carbon and oxygen isotope analysis of tooth enamel carbonate with the aim at reconstructing early life-histories and testing the hypothesis of a possible correlation between malnutrition and pathological conditions of the non-adult portion of the burial assemblage. This sampling method will provide high-resolution data on dietary changes and metabolic outcomes in a time span from pre-birth to the time of death. While paleopathological analysis of the sample revealed a framework typical of metabolic disease, this research discusses how morbidity is tightly linked to environmental conditions. Pontecagnano, indeed, was characterized by marshlands that were drained to convert them into fertile arable farmland especially between the 6<sup>th</sup>-4<sup>th</sup> centuries BC, therefore agricultural practices, access to adequate food resources, and sanitary conditions were strongly compromised in this period. Finally, this study strives to encourage a dialogue between biochemistry, archaeology and paleopathology for a broader interdisciplinary research approach.

**Keywords:** Etruscans, environment, incremental dentine, scurvy, Mediterranean

# DISPLAYING HUMAN REMAINS: EXPERIENCE FROM A 2018 EXHIBITION AT DURHAM UNIVERSITY, ENGLAND

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Ethical considerations surrounding the excavation, analysis, storage and display of archaeological human remains are more prominent in recent years. In particular, there have been many surveys of visitors to museums to explore their thoughts about the display of skeletons and preserved bodies of all ages, time periods and contexts. Overall, positive feedback is seen. This contribution aims: To present an example of one such exhibition from 2018, *Bodies of Evidence: How science unearthed Durham's dark secret*, in order to 1. Explore best practice for display of human remains and extant guidance, 2. Analyze feedback from visitors, and the potential biases that feedback might have, and 3. Assess relevant data from a Massive Open Online Course that was developed subsequent to the exhibition in 2019, and 4. Reflect on the data from a career spanning over 35 years in bioarchaeology. The results show that visitors appreciate seeing real human remains but were also surprised to see the use of a 3D printed skeleton, which was also welcomed. Visitors also felt that the real human remains had been displayed with respect and dignity. The MOOC comments on ethics and human remains generally supported the exhibition findings. However, retrospective reflections remain important.

**Keywords:** Display guidance, visitor surveys, MOOC, 3D printing

# CHALLENGING STATUS? INTERPRETING CARE IN EARLY BRONZE AGE IRELAND

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The Early Bronze Age is traditionally interpreted as a period of socio-political change in Ireland. Alongside changes in settlement patterns, trade relations, and the introduction of bronze; the introduction of a formalized, individualized, and possibly restricted burial tradition – in comparison to the collective burial of the Late Neolithic – has traditionally been associated with the rise of the ‘ideology of the individual’. A recent reanalysis of the bioarchaeology of the Irish Early Bronze Age aiming to compliment recent re-examinations of the archaeology, has resulted in the identification of multiple cases of care provision during this period. The Bioarchaeology of Care approach has been utilized to investigate these instances of care, as well as providing a lens to explore how this provision of care reflects upon the culture of the providers. The combination of multiple case studies focusing on a range of pathology, including severe osteoarthritis, non-union fracture, torticollis, and probable multiple myeloma; has allowed for a more synthesized picture of care to be constructed for this period. This series of case studies can be used to explore questions not only around what care entailed, but also who qualified for care and how status was viewed in the Irish Early Bronze Age.

**Keywords:** Early Bronze Age, Ireland, bioarchaeology of care, torticollis, non-union fracture, multiple myeloma

# TEMPORA MUTANTUR: EXPERIENCES FROM DECADES OF ANCIENT MUMMY IMAGING BY THE SWISS MUMMY PROJECT

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Diagnostic imaging of ancient mummies has changed considerably in recent decades, both in terms of technological development and popularity. Based on our experience in such endeavors, we present selected know-how relevant to best paleoradiological practice. For approximately the past twenty-five years, we have examined hundreds of human and animal mummies worldwide as part of the Swiss Mummy Project, focusing on ancient Egyptian mummies. Imaging diagnostics include established modalities such as plain radiography or clinical computed tomography and experimental avenues such as terahertz imaging. Furthermore, mummification experiments on human and animal cadaveric material helped us better understand the enigmatic findings in paleoradiology. Due to its popularity, the need for established guidelines and quality control is more important than ever. Based on our experience, well-defined research aims (hypothesis-driven rather than case-based curiosity), adequate imaging technology, and ethical considerations are most important when pursuing paleoradiological research. Ultimately, evidence-based paleoradiology will require adherence to a knowledge-based holistic approach and a genuine commitment to original data sharing and sustainable capacity building.

**Keywords:** Evidence-based paleoradiology, diagnostic imaging of ancient mummies, Swiss Mummy Project

# BRONZE AGE PALEOPATHOLOGY IN FINLAND – WHAT CREMATION BURIALS CAN AND CANNOT REVEAL?

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The acidic soil of Finland does not preserve uncremated human bone for thousands of years. That makes cremains in Bronze Age (ca. 1800-500 BC) cairns the oldest bone material that provides possibilities for large-scale human osteological and paleopathological analyses. This study covers bone finds in a total of 218 cairns in the area of Finland, with the aim to find out what pathological lesions can and cannot be observed from these cremains. The methods followed international standard methods in paleopathology, and a new method was used for porotic hyperostosis published by Rinaldo and coworkers in 2019. The main aim in studying bone finds from a total of 218 cairns was to find out what pathological lesions can and cannot be observed from these cremated remains. Totally 212 human individuals could be identified from 164 cairns. Porotic hyperostosis and slight changes associated with osteoarthritis were the most common finds. Adoption of labor intensive field cultivation in the central Satakunta region during the Late Bronze Age seems to be associated with joint changes especially in elderly males. Late Bronze Age graves featuring these pathologies in Satakunta also show early adoption of burial customs that are predominantly Iron Age phenomena in Finland, such as multiple burials and accompanying animals. Common pathological lesions such as periostitis or trauma turned out to be challenging to observe in the research material that consisted of cremated and heavily fragmented bones.

**Keywords:** Bronze Age, Finland, cremations, porotic hyperostosis, osteoarthritis

**Funding agencies:** University of Helsinki foundation, Finnish cultural foundation.

# POSSIBLE CASE OF RARE CONGENITAL VERTEBRAL ABNORMALITY (HEMIVERTEBRAE) FROM DVORINE (ARANĐELOVAC, SERBIA), DATED TO THE 16TH-17TH CENTURY

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During the systematic archaeological excavations (2016-2021) carried out by the National Museum in Aranđelovac (Serbia), the remains of a monumental medieval church were investigated, whose founder was most likely Tsar Stefan Dušan (1331 - 1346). So far, 307 tombs have been excavated inside and around the church, dating from the middle of the 14th to the middle of the 19th century. The remains of a child with a noticeable deformity of the spine are dated to the 16th-17th century (Ottoman period), when the church was destroyed, but the local Christian population continued to be buried in the same place. The individual was a non-adult with second permanent molars fully erupted, which points to the minimum age of 12 years, although the length of bones corresponded to a much younger adult. Seven vertebrae were fused in the block with abnormal curvature and incomplete segmentation, followed by various other developmental deformities. The congenital vertebral abnormality known as hemivertebrae, provoking incompleteness of vertebral column segments, can result in congenital scoliosis and be associated with a range of other structural anomalies. Signs of neurological problems associated with hemivertebrae include rear-limb weakness, paralysis, urinary/fecal incontinence, and spinal pain. Besides, neonates with hemivertebrae are usually born before term with higher mortality rates. Bearing in mind the numerous physiological problems that this individual faced, as well as the period in which he/she lived, managing to survive at least 12 years indicates the excellent care that he or she received.

**Keywords:** Hemivertebrae, paleopathology, Serbia

# INFRARED SPECTROSCOPY AS A HUMAN BONE PRE-SCREENING METHOD FOR MOLECULAR AND ISOTOPE ANALYSIS

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Following the development of modern omics science technologies, the relevance of DNA analysis has been increasing, becoming a useful tool in various research fields. This implied an increased request of bones and teeth, which constitute a biological archive not only for archaeological and geological studies but also for forensic genetic research and molecular anthropology with different purposes. In order to preserve these osteological collections from overly invasive and expensive analyses, the main goal of this work is to examine the skeletal tissues, in particular petrous bones and tooth roots, using infrared spectroscopy (FTIR) as a pre-screening method to evaluate bone quality for molecular studies. Structural and compositional changes in bone material were examined, linking genetic and stable isotope data to infrared spectral features analyzing a wide bones collection from different origin, chronology and state of conservation. Sensitive and precise parameters were retrieved from infrared spectra, describing the conservation state of the osteological findings. Results corroborate the hypothesis that the DNA is preferentially linked to the inorganic component rather than to the organic one. The parameter that provides a predictive response in terms of the presence/absence of DNA was identified, while the influence of local environmental factors prevented a firm determination of the DNA quality/quantity. The approach

adopted in this research, useful both in the molecular- anthropological and forensic fields, could overcome a serious problem of identifying osteological material for genetic analysis, giving the opportunity to understand where and how DNA is preserved.

**Keywords:** Bone preservation, FTIR spectroscopy, ancient DNA, pre-screening method, isotopic analysis

# EVIDENCE OF PELLAGRA ON 19<sup>TH</sup> CENTURY HUMAN CRANIA FROM NORTHERN ITALY BY MEANS OF C-N STABLE ISOTOPES AND ANTHROPOLOGICAL ANALYSES

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Pellagra is a disease caused by hypovitaminosis due to the absorption deficiency of vitamin B3 and/or the essential amino acid for its synthesis. The reduced consumption of the vitamin due to a severe and prolonged diet disorder, causes the classic symptoms of pellagra such as: diarrhea, dermatitis and dementia up to causing death from multiorgan failure. Pellagra, often mistaken for leprosy, affected European rural areas for over two centuries until the early decades of the twentieth century. Veneto was the region most seriously affected and the first Italian Asylum for pellagrins was established in Mogliano Veneto (Italy) in 1882. The Tedeschi Collection of the Museum of Anthropology of the Padua University (Italy) is made up of human remains who died from various pathologies including pellagra. At the skeletal level, it was observed in the past that pathological signs left by the disease are generic and typical of many forms of avitaminosis and cannot be used to define the deaths of pellagra in archaeological cases. A careful paleopathological study was conducted on individuals affected by pellagrous frenosis to enable the assessment of the presence/absence of the disease. Differential analysis was conducted considering a list of pathologies which, due to similarity in skeletal anomalies, would have complicated the diagnosis. The results obtained by mass spectrometry for the diet reconstruction were combined with the observations of the pathological signs to evaluate possible correlations. The retrieved evidence was finally compared by analyzing individuals who died from other pathologies or with unknown causes of death.

**Keywords:** Pellagra, stable isotope analysis, skeletal remains, paleopathology

# WRENCHED OFF SKULLS? – THE INTERPRETATION OF PERIMORTEM CHANGES IN SKULLS OF THE URNFELD CULTURE FROM STILLFRIED/LOWER AUSTRIA

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Inhumation burials are the exception in the Urnfield Culture (1300–750 BC). In Stillfried/Austria, some skeletons and isolated human bones were discovered in settlement pits. The anthropological investigation of over 50 individuals' skeletal remnants are of special interest as they give us insight into otherwise only cremated remains of this population. The excellent state of preservation allowed the study of even minute perimortem changes. Three intact skulls, one calvaria, and occipital bone fragment (n=5) – three from pit V5000, two from other pits – show similar, observable perimortem changes at the skull base: transverse fractures of the condyles and fractures at the tips of the mastoid processes that reveal the underlying mastoid air cells. Some skulls also show fractures on the zygomatic arch. The causes of these alterations are discussed. Carnivore scavenging is rather unlikely due to the localisation on the skull base and the relatively small size of the changes. Another interpretation is “shelf wear”, when skulls are handled a lot and placed on a hard surface. A third option is the transversal occipital condyle fracture – a rare avulsion fracture with stress of the attached ligaments and tectorial membrane, which is mostly seen in motor vehicle collisions nowadays. Maybe these fractures are signs of wrenching forces, possibly when people tried to separate the atlas from the skull base of the possibly already partly skeletonized remains during or in preparing for a ritual act. Whatever the cause, the perimortem changes testify to a cranial cult of the Urnfield period in Stillfried.

**Keywords:** Perimortem trauma, bone, Urnfield Culture, ritual

# HIDDEN LEPROSY RESERVOIRS: A MEDIEVAL *MYCOBACTERIUM LEPRAE* STRAIN RECOVERED FROM AN ENGLISH RED SQUIRREL

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Leprosy is known as one of the oldest recorded diseases in human history and is still prevalent in Asia, Africa and South America with over 200,000 cases every year. Although ancient DNA approaches on the major causative agent, *Mycobacterium leprae*, have contributed to a better understanding of this disease's evolutionary history, the role of animal reservoirs and inter-species transmission in the past are unexplored. Previous studies have detected relationships of medieval strains isolated from human remains with modern animal reservoir strains such as the red squirrel, however when and in which direction potential transmissions occurred is so far unknown. Here, we explored 25 human and 11 squirrel samples from two archaeological sites in Winchester, a medieval English city with a well-known leprosarium as well as connections to the fur trade. We reconstructed six medieval *M. leprae* genomes including a partial one from a red squirrel. Our first analysis revealed a placement of all strains on branch 3 as well as a close relationship between the medieval human and squirrel strains. In particular, the medieval squirrel strain seems to be closer related to the medieval human strains from the same site than to modern red squirrel strains, possibly indicating a so far undetected transmission in medieval times. In summary, our study represents the first One Health approach for *M. leprae* in archaeology, which includes a medieval animal reservoir strain into the picture, and highlights the future capability of such approaches to understand the disease's zoonotic past and current potential.

**Keywords:** Medieval leprosy, ancient pathogen genomics, One Health across time, animal reservoirs of diseases, ancient DNA

# PSOAS ABSCESS, HEMATOMA, OR BOTH? CONSIDERING A CASE FROM EARLY MEDIEVAL JAUNSTEIN, AUSTRIA

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Excavations led by the Austrian Archaeological Institute at the early medieval (7<sup>th</sup>-10<sup>th</sup> century CE) cemetery in Jaunstein, located in the southern eastern alpine region in Austria, uncovered one individual (2018.32) with extensive new bone formation and active inflammation in the iliac fossa. The male with an estimated age at 25-35 years has “plate-like” formations in the iliac fossa that could be sign of a psoas abscess or subperiosteal hematoma. Bioarchaeological and paleopathological examples of such cases is limited, and recorded examples indicate multiple etiologies as the cause of such a pathological insult. This study aims to consider a differential diagnosis associated with new bone formation and changes around the ilium and sacrum. Inflammation and changes around the hip are typically associated with aging and/or traumatic events. Layered new bone formation can be a sign of prolonged episodic periods of inflammation most likely causing difficult with mobility and a dependence on the existing community. In addition, other non-specific changes on the lower extremities could suggest a metabolic or genetic disturbance that may have predisposed the male individual to bleeding that would have also contributed to the changes recorded. This case can provide a unique insight into the spread of periosteal inflammation in the os coxae.

**Keywords:** Psoas abscess, hematoma, differential diagnosis, early medieval, alpine region

# PORTABLE DIGITAL RADIOGRAPHY FOR DENTAL INVESTIGATIONS OF ANCIENT EGYPTIAN MUMMIES AND DRY SKULLS DURING ARCHAEOLOGICAL EXCAVATIONS

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When examining dentitions in the study of ancient human remains, the indications for planar radiography may be easily overlooked in the age of computed tomography or digital volume tomography. However, due to its wide availability, conventional planar digital radiography remains an excellent - and often the only viable - method for examining the orofacial structures and dentition of ancient Egyptian mummies and dry skulls, especially under field conditions. Radiographs of excellent diagnostic quality can be obtained if the proper methodology is followed for the chosen projections and specimen placement. We discuss different approaches and challenges when using portable digital radiography equipment during archaeological excavations. We also provide recommendations on projections and specimen positioning in this context using selected examples from various collaborations with archaeological excavation missions in Egypt.

**Keywords:** Portable planar digital radiography, orofacial structures and dentitions, ancient Egyptian mummies

# APPLYING THE 'BIOARCHAEOLOGY OF CARE' MODEL TO A SICK DISABLED ALTRICIAL INFANT: A CASE STUDY FROM PREHISTORIC BRAZIL

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During prehistoric times in Northeastern Brazil, an infant of 9 months ( $\pm 3$  months) of age at death, lived long enough to display skeletal signs of significant physical health damage due to infectious and/or metabolic illnesses. During the course of its short life, aside from normative parental care, the child probably received additional healthcare treatment at the hands of its immediate family and other community group members. Our case study describes Individual 9 from Burial 2 at the Toca do Enoque archaeological site, located in Serra das Confusões National Park (Piauí, Brazil). This location was used as a funerary site by pre-ceramist hunter-gatherers groups during part of the Middle Holocene ( $6220 \pm 50$  to  $6610 \pm 40$  years BP). The quantity and severity of the pathological marks observed on the skeleton suggest that its survival was likely due to the healthcare administered. In addition, dedicated funerary treatment reinforced the special and careful attention given to this child by its community during its life, and after death. Despite the inherent difficulty of applying the Bioarchaeology of Care model to altricial infants, its application in this case constitutes a significant step forward into research on past health-related caregiving. One which takes into consideration the differences between normative parental-care and non-normative health-care given to children in the past.

**Keywords:** Bioarchaeology of care, altricial infants, paleopathology

**Funding agencies:** Fundação do Museu do Homem Americano – FUMDHAM / Instituto Nacional de Ciência e Tecnologia de Arqueologia, Paleontologia e Ambiente do Semiárido do Nordeste do Brasil – INCT-INAPAS.

# ORAL HEALTH IN THE LIGHT OF BIOLOGICAL CONDITION OF EARLY MODERN WROCŁAW INHABITANTS

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Oral diseases such as dental caries, periodontitis, as well as enamel hypoplasia can tell a lot about living condition and biological state of past human populations. The aim of the study is to investigate the frequency of periodontitis and dental caries, their coexistence and the influence of the biological condition of individuals (determined on the basis of the occurrence of dental enamel hypoplasia) on the occurrence of these diseases in the analysed skeletal population. The research material consisted of 317 skulls (177 females and 140 males) from an archaeological site, Salwator, in Wrocław (Poland). The cemetery is dated back to the 16th-18th century AD. Dental enamel hypoplasia was assessed macroscopically as the presence or absence of a defect. Corbett and Moore's method was used to examine caries. The occurrence of periodontitis manifestations was macroscopically assessed based on changes in alveolar bone morphology and the cemento-enamel junction, with an alveolar crest distance exceeding 2 mm. In the studied population the overall frequency of dental caries was 78,86%, periodontitis 60,25%, and enamel hypoplasia 29,97%. Both in the whole population and in a group of females, among individuals characterized by a worse biological condition (with evidence of enamel hypoplasia) an increased prevalence of caries, but no periodontitis was found. There was also a coexistence of periodontitis and dental caries in the whole population in total and in each sex group separately, as well as in the older age classes – maturus and senilis. Only in younger adults (adultus), a low biological status decreased the chances of developing periodontitis.

**Keywords:** Periodontitis, dental caries, dental hypoplasia, oral health, dental anthropology

# AN EARLY HISTORY OF THE SECOND PLAGUE PANDEMIC IN 14TH-CENTURY CENTRAL EURASIA

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The Black Death (1346–1353 CE) was the initial wave of the so-called Second Plague Pandemic, which lasted until the 19th century and is known to have affected Europe, Asia and Africa. While the pandemic has been characterized as one of the largest infectious disease catastrophes of the pre-modern era, its origins remain unclear and have been a topic of continuous debate. At present, such discussions are not only limited to the pandemic's geographic source, including the proposed regions of western, central and eastern Asia, but also include different views on its temporal framing. Moreover, ancient DNA research has to date maintained a somewhat narrow geographical focus on the Second Plague Pandemic. Ancient *Yersinia pestis* genomes have been exclusively retrieved from epidemic sites from the 14<sup>th</sup> to 18<sup>th</sup> centuries in western Eurasia. While these data have provided valuable insights regarding extinct *Y. pestis* diversity and the pandemic's progression within Europe, they have provided little information on its primary source. Here, we present newly generated ancient *Y. pestis* genomic data from archaeological sites in present-day Kyrgyzstan, central Eurasia. Such sites have been shown to contain epidemic victims from the 14<sup>th</sup> century, precisely dated based

on tombstone inscriptions. Our synthesis of archaeological, historical and ancient genomic data shows a clear association of the identified strains with the pandemic's geographic and temporal source. These data provide a precise framework towards characterizing the early dispersal history of the Second Plague Pandemic.

**Keywords:** Plague, Black Death, Second Plague Pandemic, ancient DNA

# IT'S TIME TO TALK: NAVIGATING THE COMPLEXITIES OF WORKING WITH MULTIPLE STAKEHOLDERS AT THE CAPUCHIN CATACOMBS OF PALERMO, SICILY

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The largest collection of mummified human remains (n=1,284) in Europe can be found in the Capuchin Catacombs in Palermo (Sicily). The site holds great socio-cultural significance to the city as it shows how ideological beliefs, social attitudes, and culture have changed over time. Given the importance of the Catacombs, multiple stakeholders (e.g. the Capuchin Friars, descendants of the dead, cultural heritage bodies, researchers, and tourists) dictate the way in which the deceased are curated and analyzed by scientists. The lack of investment, combined with the varied interests of each stakeholder, can make decision-making and the operation of the Catacombs challenging. This paper will explore the difficulties involved in the curation and analysis of human remains at a cultural site. Through the use of case studies, we will demonstrate the importance of collaboration and regular, transparent communication between all involved in decision-making processes at the site. This is integral to the preservation of the mummies and ability to analyze the individuals for the purpose of scientific research at a cultural heritage site, whilst ensuring the beliefs and wishes of the deceased and their families are respected.

**Keywords:** Mummies, ethics, heritage, human remains

# THE FEELING OF FAITH: ASSESSING SKELETAL ALTERATIONS IN RELATION TO POSSIBLE DEVOTIONAL ACTIVITIES IN MEDIEVAL NUBIA

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The integration of knee bending in Christian devotional activities such as genuflection has been widely attested, however, investigations of skeletal corollaries have been limited, with research on the monks of Byzantine St. Stephen's in Jerusalem currently forming the primary source of paleopathological data on such activities. Extending the inferences derived from St. Stephen's, this study examines potential skeletal alterations related to repetitive movements undertaken as part of devotional activities among monastic and ecclesiastic individuals in medieval Nubia. To complete this study the skeletal remains of coenobitic monks from Ghazali; the monk Anna and proposed high ranking church officials interred within the Monastery on Kom H of Old Dongola, the capital of Makuria; and the Bishops of Faras, the one-time capital of Nobadia, were macroscopically examined for a series of skeletal alterations at 16 locations. By including a diverse assemblage of individuals, it was possible to look at potential variation in skeletal alterations across segments of the Nubian church hierarchy and varying environments, providing opportunities to assess skeletal alteration in relation to devotional as well as potentially hierarchically mitigated activities. The results of this study identified a wide range of alterations bringing into question the nature of variation in religious activities and evident skeletal manifestations of such. This study engages with questions of religious ideology, social position, and devotion in conjunction with, and perhaps in spite of, the physical realities associated with the continued undertaking of repetitive movements over extended periods of time.

**Keywords:** Medieval Nubia, Makuria, Nobadia, coenobitic monasticism, Sudan

# MAPPING PAST PARASITISM: A GLOBAL ANALYSIS OF PALEOPARASITE DISTRIBUTION

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This work aims to summarize the global evidence of human paleoparasite distribution published thus far with the objective of analyzing how these infections might have impacted the health and wellbeing of past populations and inferring cultural and social practices related to pathoecology and parasite transmission. This work gathered all the available data in paleoparasitology and mapped the global distribution of parasites found according to their prevalence, transmission type (e.g. food-borne, water-borne, etc.), and relevance to the lives, health, and wellbeing of past populations. It was found that infection by soil-transmitted helminths dominated regions such as Europe and North America, indicating that hygiene and sanitation levels were low in these locations. Foodborne parasites were also prevalent in the global data, indicating that many populations around the world ate raw or undercooked meat, seafood, and other foodstuffs as a component of their diet. Further patterns were noted in the data, particularly concerning the distribution of ectoparasites and vector-borne diseases. However, it was also found that more research is needed in more locations in order to determine the validity of these patterns; furthermore, additional research is needed to determine the true significance of parasitism for past individuals and populations.

**Keywords:** Paleoparasitology, parasites, pathoecology, parasitic infection

# DIET AND STRESS IN INDIVIDUALS FROM CATHKIN PEAK ROCK SHELTERS (DRAKENSBERG), SOUTH AFRICA

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Eight skeletons from six rock shelters, dating mostly from the 14<sup>th</sup> to mid-17<sup>th</sup> centuries, were excavated from the uThukela region of the Drakensberg (South Africa) in the 1930s. One was older, dating to between the 7<sup>th</sup>-9<sup>th</sup> centuries. These skeletons have not been extensively analyzed before. The aim of the study was to assess these remains particularly with regard to disease, diet and stress. The remains included adults of both sexes and children. Cranio-metric and stature assessments suggest that they were Bantu-speakers. Three individuals were juveniles, which may suggest high mortality for younger individuals. The only juvenile with teeth available showed clear enamel hypoplastic lines and subperiosteal bone growth. Of the four individuals with teeth, three had carious lesions and advanced dental wear. This suggests a diet that was both cariogenic and abrasive. One adult individual had inactive cribra orbitalia, and two others presented with healed fractures. A young adult female with faint enamel hypoplastic lines were associated with a fetal bone, suggesting death during pregnancy / childbirth. Stable isotope analyses indicated a predominantly plant-based diet. The dates correspond to the Late Iron Age Moor Park phase of the Blackburn branch and represent the early movement of Bantu-speaking farmers into the higher-altitude interior regions of South Africa. Migration to the higher-altitude regions suggests a defensive purpose in response to social instability, perhaps brought on by environmental impacts on agriculture caused by the Little Ice Age (AD 1300 – 1800). These hardships are supported by the skeletal analysis.

**Keywords:** South Africa, Late Iron Age, paleopathology

# PATHOLOGICAL ANALYSIS OF SKELETAL REMAINS FROM ONE OF VIENNA'S OLDEST CHRISTIAN CEMETERIES

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In the autumn of 2021, an excavation of Petersplatz street and surrounding streets in the Vienna city center found the remnants of a medieval graveyard belonging to St. Peter's Church. Presumably, this graveyard is one of the oldest Christian medieval cemeteries within Vienna, Austria. Due to the limitations of the trench size and previous grave disturbance (e.g. construction, looting, reburial), only 16 individuals were complete or nearly complete for analysis. This research aimed to assess living environment of individuals who lived in medieval Vienna, Austria. Living conditions were determined through an in-depth analysis of respiratory disease and metabolic disorders. Respiratory disease was investigated by looking for signs of inflammation within the paranasal sinuses and along rib surfaces. Metabolic disorders were determined by identifying indicators of deficiencies, this included signs of scurvy, rickets, and cribra orbitalia. Fifty percent (8/16) of the analyzed population had evidence of maxillary sinusitis, while 44% (7/16) presented with rib lesions. Seventy-eight percent (7/9) of non-adults had pathologies indicative of metabolic disorders. As well as 75% (12/16) of the analyzed population exhibited indicators of respiratory disease. These findings suggest that the medieval community, especially this sampled population, in Vienna was affected by environmental stress. Therefore, the Viennese urban population was exposed to negative health factors that could be potentially related to air pollution, and lack of nutritious food sources. The ongoing excavations at Petersplatz will increase our knowledge about the urban living conditions in medieval Austria.

**Keywords:** Paleopathology, vitamin D & C deficiency, medieval, urban, rib lesions

# COEXISTENCE OF DIFFERENT SPINE DISEASES: AN EXAMPLE FROM THE VÁC MUMMY COLLECTION (18<sup>TH</sup>-19<sup>TH</sup> CENTURY AD)

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In 1994, a long-forgotten crypt with an ossuary was found at the Dominican church of Vác, Hungary, during restoration works. Archaeologists uncovered 265 individuals who had been laying intact in their coffins for centuries. The condition of the corpses spanned from completely skeletonized individuals to pristinely preserved mummies. In several cases, the full names and dates of death of these individuals were gathered from inscriptions on their coffins. Their identities, family relationships, and even financial circumstances were retrieved by matching them with historical documents and records. In 2021, we launched a new project at the Department of Anthropology of the Hungarian Natural History Museum following the development of new scientific research methods and as a consequence of the diverse conditions of the bodies, which needed further investigation. The project is informed by previous research and it aims to review the Vác mummy collection and conduct additional multi-disciplinary investigations. Inspection of one of the subjects, a middle-aged priest, revealed clear spinal and extraspinal manifestations of DISH (Diffuse Idiopathic Skeletal Hyperostosis), including candle-wax appearance, which was also combined with an almost complete fusion of the thoracic trait. This presentation will provide details about the biological profile, pathological features, and sociocultural context of this specific individual, and will illustrate future research plans on this mummy assemblage.

**Keywords:** Mummies, spine, disease, paleopathology

# EVIDENCE OF LEGG-CALVÉ-PERTHES DISEASE IN TWO ADOLESCENT INDIVIDUALS FROM A MEDIEVAL CEMETERY IN NORTHERN ITALY: A PALEOPATHOLOGICAL CASE OF FAMILY HISTORY?

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Legg-Calvé-Perthes disease (LCPD) is triggered by the avascular necrosis of the femoral head, resulting in cystic foci inside the epiphysis and metaphysis, deformity of the femoral head (mushroom-shaped), broadening and shortening of the femoral neck, femoral head anteversion, and biomechanical impairments. The necrosis usually onsets in developing children about 4–8 years old, with a predisposition for males. The condition is commonly unilateral but can involve both the femoral heads in 10–20% of cases. Although the condition is not hereditary, several studies found a familial predisposition, supporting that pathogenesis should rather be sought in coagulation disturbances. Furthermore, a correlation with some mutations of the COL2A1 gene has recently been identified. LCPD has also been found associated with other conditions such as secondary osteochondroses, osteochondritis, and spina bifida, reinforcing the hypothesis that this condition is the local manifestation of a systemic disease that requires further investigation. Here, we present two cases of probable LCPD in two adolescents unearthed in aligned burials in the medieval levels of a cemetery in Northern Italy. The subjects present severe alterations and necrotic evidence of both femoral heads, with major involvement of the left side. The presence of other similar skeletal changes associated with evidence of bilateral LCPD, the burials proximity, as well as the close age-at-death intervals, allow us to speculate on the kinship of the two subjects. Archaeogenomic analyses are being performed, which would allow us to recognize a paleopathological case of familial susceptibility, until now found only in clinical studies, in two osteoarchaeological individuals.

**Keywords:** Bone paleopathology, paleogenetics, osteochondrosis, circulatory disease, childhood disorder

# DENTAL MUTILATIONS ON WEST AFRICAN SKULLS – POSSIBILITIES AND LIMITS OF AN ETHNIC CLASSIFICATION

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In 2012, the Museum of Prehistory and Early History in Berlin took over the expanded Felix von Luschan Skull Collection. Together with the Rudolf Virchow Skull Collection, with which it is closely linked via collectors and sites, it is one of the largest skull collections worldwide. Since 2017, human remains from colonial contexts have been studied in several research projects in an interdisciplinary manner, whereby collaboration with colleagues from the countries of origin is an essential component. Since 2021, the BKM-funded project has been examining human remains from the former German colonies in West Africa. Of the almost 500 skulls from the former German colonies in West Africa, 93 skulls come from Cameroon. These are exclusively skulls of mostly young men who worked on the construction of the Cameroon-Northern-Railway and then died in the military hospital at Ndunge in the Manenguba-Mountains. The doctor Hans Schäfer donated these skulls to the Museum für Völkerkunde in Berlin in 1911. The ethnicity and place of origin are noted on the left parietal of each skull. Thus, these skulls can be located very well. Many of these individuals show different dental-mutilations. In this article, we want to find out whether the different ethnic groups had different dental mutilations. Since dental mutilations are still carried out in Africa today, field research will be carried out with colleagues in the countries of origin, especially in Cameroon, to find out whether a tradition in the type of dental mutilations can be established. The results obtained can then also be used helpfully in the provenance-research of less well documented skulls.

**Keywords:** West Africa, former German colonies, Berlin, Felix von Luschan Skull Collection, dental mutilations

# CHEST DEFORMITY IN A MEDIEVAL WOMAN FROM LINCOLN – A POSSIBLE CASE OF PECTUS CARINATUM

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Excavations at Beaumont Fee in the center of Lincoln, England uncovered 23 inhumations dating to the Medieval Period (11<sup>th</sup> to 13<sup>th</sup> centuries). One of the burials was that of an old adult female. The positioning of the burial in the cemetery was unremarkable, so no information on social status could be determined. However, the individual was positioned supine with hands over the pelvis and had good preservation with minimal fragmentation. Abnormal changes to the thoracic cavity were observed with an alternate concave and convex shape to the manubrium and sternum and the abnormal angulation of the ribs suggesting an anterior displacement of the chest, possibly caused by ‘Pectus Carinatum’. This paper will hopefully provide an insight into the impact this type of pathology would have had on the health and wellbeing of an individual during the Medieval period in Britain.

**Keywords:** Pectus Carinatum, paleopathology, England

# THE NEED FOR STANDARDIZATION IN THE RECORDING OF SPINAL PATHOLOGICAL LESIONS

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The study of spinal pathology can provide useful information on the health, wellbeing, environmental and occupational stresses of past populations. During a project analyzing and recording spinal pathology and trauma in over 515 individuals from Sudan, the lack of comparable data became apparent, and this was in part due to the lack of studies on spinal pathology in Nubian populations, but also a result of the lack of standardization in the collection, analysis and presentation of data. This poster discusses this issue and presents the importance of collecting and presenting data both by individuals (crude prevalence rate) and by element (true prevalence rate) as well as including the actual number of individuals/elements affected compared to the number of individual/elements available for analysis. Therefore, providing a standard that should be adhered to in future projects on spinal pathology (as well as other bioarchaeology analysis) to ensure data can be used for comparative studies. This in turn will build on our knowledge and help provide a clearer picture of the health and daily life of the populations being studied.

**Keywords:** Spine, pathology, standardization

# ADAPTIVE STRATEGIES FOR ADVERSE ENVIRONMENTAL CONDITIONS: A PALEOPATHOLOGICAL INVESTIGATION OF PHYSIOLOGICAL STRESS MARKERS IN PRE-ROMAN ITALY

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The analysis of physiological stress markers offers direct insights into the health status of ancient communities, shedding light on their adaptive strategies, at different life stages, to the cultural and biological environment. The present research pertains to the paleopathological investigation of 109 individuals, inhumated in the funerary sector of Di Renna, within the eastern necropolis of Pontecagnano (Salerno), one of the best archaeologically-documented pre-Roman sites of Italy; the burials are dated back to the Iron Age and Archaic period (8<sup>th</sup> – 6<sup>th</sup> century BC), but most of them to the Classical period (5<sup>th</sup>–4<sup>th</sup> century BC). The purpose of this research is to explore general health conditions, through the analysis of several skeletal and dental stress markers, including adult and non-adult stature, dental enamel hypoplasia, cranial porosities, cribra femoris, and periosteal reaction of the lower limbs. High prevalence of these lesions and some cases of short adult stature were detected, suggesting evidence of stress episodes, frailty, and nutritional deficiencies, occurring not only in childhood, but also during growth spurt and adulthood. These results might be interpreted evaluating the socio-economic transformation of the site during the Classical period, characterized by mobility of Samnite groups and cultural admixture with Greeks, Etruscans and other Italic people already settled in the area. The individuals likely experienced a complex relationship with adverse environmental conditions (e.g., food shortage, poor sanitation, elevated risk of disease) and they coped with these constraints with long-term skeletal consequences as adaptive response to stressors, possibly related to the different historical phases of Pontecagnano.

**Keywords:** Cribrous lesions, periosteal reaction, stature, Samnites, Mediterranean

# EVIDENCE OF VIOLENCE AMONG THE NORDIC CORDED WARE GROUPS

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The last decade of archaeo-genetic research has revealed substantial biocultural changes setting forth in Europe around and after 2900 BCE. In the Nordic region, the First Farmer population vanished, fled into retreats, or became absorbed by Corded Ware (CW) lineages of the newcomers whose genetic ancestry traces back to pastoralists of the Eurasian Steppe. Researchers currently discuss causes, effects, and timelines. There are numerous reports of CW violence in skeletal remains from central Europe, but in which ways were acts of violence part of the Nordic CW groups? So far, violence among the Nordic CW groups has only been reported on case basis, but population frequencies are unknown. Weaponry is commonly found in Nordic CW contexts but there has been an archaeological consensus that battle axes, commonly found in male burials, were ceremonial prestige objects and not suitable in combat. Here, we present evidence of violence in skeletal remains from Sweden and Denmark. Most violence-related trauma correlates to blunt force violence to the head, but in core areas, the use of projectiles seems elevated. It is likely that this corresponds to inter-group conflict over local resources. Based on skeletal evidence, we also argue that the battle axe was, in fact, used in combat and should not be regarded solely as ceremonial objects.

**Keywords:** Violence, Corded Ware, blunt force trauma, battle axe, Scandinavia

# EXAMINING DIETARY ISOTOPIC VARIATION AMONG INDIVIDUALS WITH PROBABLE TUBERCULOSIS FROM LATE PREHISTORIC KUELAP, PERU

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This paper explores expectations of pathology-influenced isotopic variation in skeletal samples where tuberculosis (TB) has been diagnosed and considers the impact of this infectious disease on dietary interpretations. Other studies have modeled chronic nitrogen imbalance impacting the stable isotope ratios systemically and locally in bone. This study examines stable isotope ratios of carbon, nitrogen, and oxygen in bone from 12 adults (6 males and 6 females) with skeletal lesions consistent with tuberculosis and compares them to a sample (n = 46) of contemporaneous adult males and females from the Late Intermediate Period (CE 800 – 1470) and Late Horizon (Inca Conquest CE 1470 – 1535) Chachapoya site of Kuelap, Peru. TB individuals' bone  $\delta^{13}\text{C}_{\text{coll}}$  values average  $-13.39\text{‰} \pm 1.4$ ,  $\delta^{15}\text{N}$  average  $7.93\text{‰} \pm 0.6$  and  $\delta^{18}\text{O}_{\text{sc}}$  average  $-6.43\text{‰} \pm 0.52$ . There are no significant differences across samples, either based on location of skeletal lesions, sex, or time period, except for nitrogen values, where TB females are enriched on average compared to TB males and non-TB females. The degree of destruction and evidence of healing of both vertebral and extravertebral lesions suggest many of these individuals had lived with TB over several years. It is possible that the non-TB samples included individuals also infected with TB but without observable skeletal lesions, and therefore the lack of statistical difference is due to similar diet or similar pathophysiological responses to endemic TB. Alternatively, this infectious disease may have more significantly impacted female metabolic stress levels, or that they consumed dietary resources distinct from others at the site.

**Keywords:** Skeletal lesions, infectious disease, diet, stable isotopes, Peru

# A MULTI-METHODOLOGICAL APPROACH TO EXPLORING DIET, HEALTH AND DISEASE AMONG LATE ANTIQUE AND MEDIEVAL POPULATIONS FROM APULIA

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This research uses a multi-methodological approach to understand the diet and health of cemetery populations from southern Apulia (Italy), dating between the 4th and 14th centuries CE. Paleopathological analysis was combined with carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) stable isotope analysis of 61 individuals from the sites of Vaste (20 adults, 15 non-adults), Le Centoportre (8 adults, 2 non-adults), S. Maria di Cerrate (4 adults, 2 non-adults) and S. Maria di Miggiano (7 adults, 3 non-adults) alongside an animal baseline (n=29). Furthermore, isotopic analysis of dentine serial sections was carried out on 9 individuals from Vaste (2 adults and 7 non-adults), to reconstruct infant weaning and childhood diet. Isotopic data from bone collagen indicates there was no sex-based difference in diet and a lack of diachronic patterning in diet between Late Antiquity and the Middle Ages among the sampled sites. Exploration of the isotopic results alongside observed pathologies (linear enamel hypoplasia, cribra cranii, cribra orbitalia and arthritis) indicates no discernable isotopic difference between those individuals with pathological conditions and those without. At Vaste, isotopic data from teeth indicates that weaning was completed by around three/four years of age. Altogether, these data, combined with those of infant mortality and enamel hypoplasia at Vaste, also provides a window on childhood lifeways at this Late Antique site. **Keywords:** Stable isotopes analysis, diet, weaning, infant feeding practices, Late Antique/Medieval Apulia

# A NEW PROCEDURE OF STATURE RECONSTRUCTION BASED ON OSTEOLOGICAL DATA

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Stature is an important morphological characteristic in both present and past populations. Stature variation in time and space could be one of the indicators of environmental changes. Developing strict procedures of stature reconstruction is crucial for proper data interpretation. Mathematical and anatomical methods are the most commonly used in physical anthropology. The mathematical method is more widely used because it is less time-consuming, and based on developing formulas from the length of individual long bones, which makes it possible to calculate the stature of an individual with poorly preserved skeletal remains. Hundreds of mathematical formulas for populations with different morphological characteristics were developed. Accordingly, stature of populations with similar proportions can be calculated using the same formula. The first step of the proposed procedure is a selection of a proper formula through the comparison of mathematically derived proportions of the population, on which the formula was developed, with the proportions of the analyzed sample. Standard deviations that are indicated for each formula may be wide. Therefore, statistical significance of the revealed difference in indicators may raise questions. The proposed procedure enables narrowing of the stature intervals without losing the accuracy of their indicators. The integration of estimated stature for each available long bone allows the calculation of the mean and statistically significant narrowed interval. Additionally, the statistical probability of reliability of the results is calculated. Procedure will be verified through the analysis of sample (N=129) with known sex, age, stature, ancestry, and postcranial metric data from the Forensic Anthropology Data Bank.

**Keywords:** Osteometry, stature, formulae

# TREPANATION PRACTICES DURING THE EARLY AND MIDDLE BRONZE AGE IN THE NORTH PONTIC REGION

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The Bronze Age in the North Pontic region was a period of a widespread trepanation practice: 23 skulls with signs of trepanations and surgical interventions are examined in the present study. The majority of the cases originate from Catacomb culture burials. Only two of them are observed among Yamna culture materials. Most of the skulls in question belong to adult (*adultus*) and mature (*maturus*) males. Female skulls (mainly *adultus*) are twice fewer in the collection. Two out of four trepanation techniques described by F. P. Lisovsky were used during the Early and Middle Bronze Age in the North Pontic area. Most of these trepanations were made by scraping, and the lesions that form this group are generally healed. Besides this, two cases of boring-and-cutting trepanations were found in Catacomb culture burials from the Steppe region. None of them show signs of healing. The largest part of the lesions is located on the parietal bones (with a predominance of the left bone in the males, and the right in the females). Traces of preliminary trauma in the area of surgical interventions are observed in more than half of the cases. This confirms the idea that the main purpose of these operations was medical.

**Keywords:** Trepanations, Bronze Age, Ukraine, North Pontic region

# AUGUSTO BONOME AND HIS PIONEERING STUDIES ON LEPROSY: A CASE OF TUBEROUS LEPROSY WITH BONE DYSTROPHIES

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Augusto Bonome (1857-1922) was professor of general pathology and bacteriology at the University of Padua and director of the Institute of Pathological Anatomy from 1889 to 1922. Starting from 1888, Bonome was involved in a study about a particular kind of pulmonary leprosy, being the first to testify the lepromatous alterations also in the deepest parts of the respiratory tract, even though the same Gerhard Hansen (1841-1912) had denied the possibility that lungs could host *Mycobacterium leprae* since he, and others at the time, believed that the nodular and ulcerous localizations in leper lungs were caused by the concomitance of pulmonary tuberculosis and tuberculous leprosy and anesthetic leprosy. Bonome's advances in leprosy studies are testified by some specimens from the Morgagni Museum of Pathological Anatomy of the University of Padua, which he contributed to enrich following the legacy of his predecessor, Lodovico Brunetti (1813-1899), founder of the Museum in the 1860s. Among the specimens, there is a peculiar case of advanced tuberculous leprosy in a 16 years old boy, died in 1908, of which the face, the larynx, the hands and genitals are still preserved today in the Museum. Through autoptic and histological analysis, Bonome succeeded in identifying a peculiar case of bone toxoid-infectious dystrophy besides a characteristic leprous laryngitis, that caused the death of the leper boy, thus confirming the innovative research carried on by Bonome during his medical career.

**Keywords:** Leprosy, history of medicine, infectious disease, bone dystrophies

# PEDIATRIC PALEORADIOLOGY: APPLICATIONS AND BEST PRACTICE PROTOCOLS

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This study evaluates the use of paleoradiology techniques in the analysis of pediatric remains. It offers evidence-based, best-practice protocols for the use of advanced imaging techniques in the assessment of pediatric remains from archaeological contexts and provides a recommended reporting worksheet for recording findings in a standardized way. Although radiological techniques are used with increasing frequency in the assessment of pediatric remains, no standardized pediatric imaging protocols presently exist. An interdisciplinary team consisting of historians, anthropologists, bioarchaeologists, pediatric radiologists, musculoskeletal radiologists, and a radiographer combines insights gained from existing literature with current clinical imaging protocols in order to provide best-practice protocols for the acquisition and reporting of findings from archaeological contexts, specific to pediatric remains.

**Keywords:** Children, human remains, paleopathology, paleoradiology

## PATTERNS OF LINEAR ENAMEL HYPOPLASIA AND WEANING

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Linear enamel hypoplasia (LEH) is a commonly investigated pathology when studying past living conditions. Structures are caused by (non-specific) exposure to stress resulting in a disruption of the development of tooth enamel. Thus, linear defects on enamel can give record on an individual's early life history. The period of weaning is known to cause stress, presumably due to the reduction of nutrients, complementary foods contaminated with pathogens and loosing immune defensives provided in breast milk. Early introduction of complementary foods and shorter weaning periods may play a significant role. Time and duration of the weaning period can be reconstructed using serial carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) isotopes analysis of tooth dentine from first molars (M1). Isotope profiles from first molars of 38 individuals from Late Antique and Early Medieval Bavaria were compared with the enamel pattern on their anterior teeth. Observed weaning pattern are highly variable. The introduction of complementary food or the cessation of breastfeeding does not inevitably result in the formation of LEH. However, LEH often occurs towards the end of weaning or shortly after. Although weaning pattern and the presence of LEH can be influenced by various factors, our results indicate that the introduction of complementary food, but also the transition to 'adult diet' may have facilitated malnutrition or disease and thus caused stress resulting in LEH.

**Keywords:** Childhood, linear enamel hypoplasia, stable light isotope analysis, weaning

## THE 16<sup>TH</sup>-CENTURY MASS GRAVES OF MOHÁCS (HUNGARY): A CHALLENGE FOR FIELD AND FORENSIC PALEOPATHOLOGY

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In 2020, the Szeged anthropology team was asked to carry out the field anthropology work of the 1526 Mohács battle Mass Grave No 3 and contribute to the studies of the remains. Although the field anthropological and paleopathological work is still in progress and an important part of the skeletal material is only partially excavated, some preliminary observations are to be made. According to the archaeological artifacts, in the mass graves of the Mohács Memorial Park, we could find the skeletons of Hungarian soldiers serving in the Army of the Hungarian Kingdom, as well as Czechs, Croatians, Poles, and Germans, that is the Christian Coalition Army, which tried to stop the Ottoman Army led by Suleiman the Magnificent on August 29, 1526. The most remarkable osteoarchaeological observation is the abundance of perimortem cut wounds observed first of all on skull bones and cervical vertebrae. These wounds frequently indicate that the cervical spine received several cuts, from behind and from above, and these cuts hacked across the cervical spinal cord several times. These observations suggest that the 5 mass graves of the Mohács Memorial Park may reflect the mass execution date of August 31, 1526, when Suleiman ordered the execution of about 2000 prisoners of the battle. However, the excavation is not finished yet – it should be completed, the skeletal identification must be completed too, and a very accurate paleopathological and forensic anthropological study is to be carried out to validate or deny our preliminary hypothesis.

**Keywords:** Mohács battle, field paleopathology, cut wounds, mass execution

**Funding agencies:** This research was supported by the National Research, Development and Innovation Office, Hungary (project No. K 125561).

# SCURVY AS A SILENT WITNESS OF POOR HEALTH AND DIET OF THE CHILDREN LIVING IN EARLY MODERN SUBURBAN TALLINN, ESTONIA

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A large scale paleopathological research of 192 non-adult skeletons from early modern period Tallinn (16th to 18th century AD), Estonia was undertaken to investigate the health and living environment surrounding these children. The sample represents individuals from the lower social class, who probably lived in poor conditions that undoubtedly left a mark on their health. Paleopathological analysis was used to obtain more information about a part of society (poor, suburban children) typically underrepresented in other historical and archaeological sources. The results indicate high rate of metabolic diseases with both rickets and scurvy prevalent among the children. Possible cases of tuberculosis and different non-specific stress markers were also present which illustrate poor environmental conditions. Scurvy rates were exceptionally high among infants and young children, with over 60 percent of children affected by the disease. Possible reasons behind this include unsatisfactory maternal health, early cessation of breastfeeding, and weaning foods low in vitamin C. Although famines were a constant threat in early modern period Estonia, the reasons behind high levels of scurvy would have more likely been cultural, rather than caused by famines or poverty. This is indicated by the lower or non-existent prevalence of metabolic diseases among older children who probably had a more similar diet to the adults, consuming more meat, fish, and vegetables, which would have provided sufficient vitamin intake.

**Keywords:** Non-adults, paleopathology, scurvy, diet, Estonia

# CANCER IN PREHISTORIC FARMERS – A CASE OF MULTIPLE MYELOMA

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Cancer is a widespread disease today, but it has also occurred in older historical periods. One of the most commonly reported forms of malignant disorder of skeletal remains is multiple myeloma, a bone tumour of hematogenous origin that manifests on the skeleton in about 80-90% of patients. We noticed typical signs of multiple myeloma on the skeleton of an adult female from the Troubsko site in the Czech Republic. The studied female belonged to the people of the Bell Beaker Culture, who lived in the Czech lands between 2500-2200 BC. Detailed paleopathological analysis recorded osteolytic lesions on the flat bones of the skull, characteristic of manifestations of multiple myeloma. The diagnosis was also supported by radiological and histological examinations. Metastatic carcinoma, Langerhans histiocytosis, leukemia and some infectious diseases were also considered in the differential diagnosis. However, histological examination clearly confirmed the diagnosis of multiple myeloma. The only older evidence of this disease in Europe is the Neolithic case from Mauer, Austria, described in 1990 by Strouhal and Kritscher. The presented finding is probably the second oldest described case of multiple myeloma in Europe and may contribute to further our knowledge of the history of this disease.

**Keywords:** Malignant disorders, blood diseases, Eneolithic

# THE ASSOCIATION BETWEEN INTESTINAL PARASITE INFECTION AND CRIBRA ORBITALIA IN THE MEDIEVAL POPULATION OF CAMBRIDGE, UK

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The consensus of opinion among biological anthropologists is that cribra orbitalia is a skeletal indicator of chronic anemia in an individual. There has been debate as to whether any type of anemia will cause it, or only specific etiologies such as iron deficiency. A number of papers have proposed that the widespread occurrence of cribra orbitalia in past populations may be due to chronic intestinal parasite infection, as parasites often cause anemia today. Our aim is to investigate whether there is any association between intestinal parasite infection and cribra orbitalia in the medieval population of Cambridge, UK. The individuals under study were excavated from the Augustinian Friary and the All Saints by the Castle parish cemetery. We undertook parasite analysis of the pelvic sediment and control samples of 43 burials with intact orbital roofs. Human roundworm (*Ascaris lumbricoides*) and/or whipworm (*Trichuris trichiura*) were identified in the pelvic sediment of 19 individuals, and cribra orbitalia was noted in 11 individuals. Chi square test showed no association between parasite infection and cribra orbitalia ( $p=.921$ ). Although roundworm and whipworm infections are known to cause anemia in modern populations, we found no association between infection and cribra orbitalia infection in this medieval population. It is possible that only parasites that cause marked anemia (such as hookworm, schistosomiasis or malaria) may cause cribra orbitalia, while less marked anemia from roundworm and whipworm may not do so. However, our findings do not support the hypothesis linking intestinal parasite infection and cribra orbitalia formation.

**Keywords:** Paleoparasitology, cribra orbitalia, Middle Ages, England

# BIOMECHANICS OF PHYSICALLY IMPAIRED INDIVIDUALS IN MEDIEVAL IRELAND

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It is difficult to visualise how individuals in the past would have functioned with physical impairments and how treatment may have increased their mobility. Disability is not defined by a set of disease conditions; individuals will have different experiences of their condition depending on the nature of their environment, culture, social status, and skills. Thus, the day-to-day quality of life of an individual, and associated limitations in activity or restriction in participation, cannot be inferred from macroscopic analysis of bone alone. Bone can adapt according to the mechanical stresses placed on it. By assessing the amount of cortical bone in long bones using radiographs, allows comparison of limbs for signs of weight bearing, revealing the level of function after injury/illness. This along with macroscopic analyses will reveal if the individual used walking aids following incapacitation of their lower limbs. From this, the level of care they may have required can be established, revealing information about the type of community these individuals lived in. Three-dimensional musculoskeletal models of the physically impaired individuals will be developed to allow visualisation of their gait revealing how they may have functioned on a day-to-day basis. Assessing the impact of physical impairment in an archaeological setting will reveal information about the care and treatment in the past and will also show the development and outcome of diseases and injuries if left untreated medically.

**Keywords:** Medieval, Ireland, disability, bioarchaeology, biomechanics

# PROTEOMICS OF ANCIENT IMMUNOLOGY: REFINED METHODS TO DETECT ACTIVE LEPROSY IN MIEVEAL INDIVIDUALS

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Paleopathology and ancient DNA, often used in tandem, have been successfully used to identify diseases in past individuals. While this provides an effective method to detect pathogen presence, much remains unknown about identifying active infections and the host response to past pathogens. Protein analysis offers new insights into how the immune system of those suffering from infections and diseases responded. However, proteomic analysis of bone and dentine samples are often complicated by an overwhelming presence of collagen, the most abundant protein in both tissues. Tandem mass spectrometry focuses on the most common peptide masses which often leads to collagen “swamping” out lower abundance peptides, leaving these lower-abundance proteins undetected. Here we present a protocol combining a recently developed digestion enzyme to reduce collagen with optimized extraction steps to specifically target immune proteins that would be otherwise hidden. We conducted comparisons of tissue types, denaturation agents, extraction fractions, and digestion enzymes in order in order to identify the most effective protocol for identifying the non-collagenous portion of the proteome, specifically focused on immune-related protein recovery. We illustrate our optimized methodology through a combined DNA and protein immunological case study of individuals from a medieval Spanish leprosarium, as well as four individuals interred in a non-leprosy associated context. Through this

combined approach, we have identified specific immune-related proteins that may indicate active leprosy infections at the time of death of these individuals. The results of this study have widespread implications for future work, and present numerous possibilities for paleopathological/biomolecular studies focused on past health and disease.

**Keywords:** Leprosy, immunology, proteomics, DNA

# ABNORMAL BLOOD VESSEL IMPRESSIONS AND PERIOSTEAL APPPOSITION IN AN EARLY MODERN POLISH POPULATION – UNDERREPRESENTED CASES OF PALEOPATHOLOGY

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Endocranial lesions observed in historical skeletal material have been studied by different researchers for many years. However, systematic studies are still rare, which might be connected to difficulties in examination of the endocranium. The presence of the lesions might be overlooked if the skull is not dissected in post-mortem examination or damaged during the deposition, and the visibility of the intracranial surface is not available for paleopathological examination. The main goal of the research is to present the problem of prevalence and morphological forms of two kinds of endocranial lesions: abnormal blood vessel impressions (ABVI) and periosteal apposition (PA) in the context of the sex, and age at death of the individuals from an early modern (16<sup>th</sup>-19<sup>th</sup> century) cemetery in Wrocław (Poland). The examined abnormalities are mainly related to inflammatory processes within the meninges. In the present study, 144 skulls were examined. The cranial vaults have been inspected with an endoscope device for the presence, localization, and severity of ABVI and PA. Over half (53.5%) of the examined individuals were affected by ABVI or/and PA. The mildest severity alteration was the most commonly observed (ABVI –19.4%; PA - 16.7%). No correlation between age and prevalence or severity of ABVI or PA was detected. However, women (40.7%) were affected more often by PA than men (24.7%). It can be concluded that the lesions observed within the inner surface of the cranium are underrepresented in standard anthropological examinations and systematic studies with the use of even simple endoscopic tools might enrich paleopathological knowledge regarding the prevalence and possible etiology of these intracranial lesions.

**Keywords:** Intracranial lesions, abnormal blood vessel impressions, periosteal apposition

# FOUR CASES OF HYPEROSTOSIS FRONTALIS INTERNA IN THE ANCIENT COLONY OF AMVRAKIA (600-200 BC)

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**Objective:** To present four cases of hyperostosis frontalis interna (HFI) in an ancient Greek population. **Material:** Skeletal remains from graves recovered from the Western Necropolis of Amvrakia, a Corinthian colony established in 625 BC in Epirus, Greece. **Methods:** The frontal bones are analyzed employing morphological and radiographic methods. We have applied macroscopic observation and CT scanning. Taphonomic analysis was conducted for enhancing the biological information. **Results:** One male ( $\geq 50$ yo), two females (20-35yo and 35-50yo) and an adult of undetermined sex show morphologically and radiographically lobular appositions of various shapes, outlines and sizes on the endocranial surface of frontal bones. **Conclusions:** Our data support diagnoses of HFI on all the frontal bones that were examined by CT scanning. **Significance:** These cases are considered, to our knowledge, to be the first discoveries and diagnoses of HFI in a population from ancient Greece. **Limitations:** The study of HFI is hindered by the difficulty of the macroscopic approach to the endocranial surfaces of frontal bones. **Suggestion for Future Research:** Histological studies may further enrich the information obtained from CT scanning and provide a multidisciplinary framework for paleopathological studies.

**Keywords:** Metabolic disorders, hyperostosis frontalis interna, bioarchaeology, ancient Greece, Amvrakia

# THE DESERTIFICATION OF THE ANCIENT OASES IN HAN DYNASTY (202 BC–220 AD) IN NORTHWESTERN CHINA

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This project investigates the desertification of ancient oases during the Han dynasty (202 BC– 220 AD) in Hexi corridor located in Gansu, China. To aid this process, archaeological evidences and historical literature records will be examined. There were more than 120 ancient cities in the Hexi corridor during the Han dynasty, the highest number of ancient cities preserved with all its diversities from the different times in history. However, the oases suffered desertification due to anthropogenic activities that took place around 2,000 years ago. The desertification of the ancient oasis in the Hexi Corridor was mainly caused by the political and military situation, the introduction of farming and animal husbandry, the utilization of water resources as well as the people's lack of understanding of the natural environment. The main reason for the desertification in the late Han Dynasty can be pointed to the inception of a large-scale development of agriculture. Wudi Emperor built up Hexi through the setting up counties as well as having soldiers and people move to the border zones for the system of Tun Tian (the process of setting up garrison stations for troops and peasants to open up wasteland and to grow food grains). This resulted in the rapid growth of the economy and society of Hexi, which allowed it to become an area that was known to be rich in resources in the whole of northwest of China. However, the ill effects of the development of Hexi were many. The hinterland of the oasis was affected due to aggressive land reclamation and some downstream areas suffered water scarcity due to the large amounts of water diverted for the farmland. In addition, these areas were located at the forefront where sand erosion had taken place. The vegetation in sand fixing areas too suffered due to the increase in the number of quicksand and this can be attributed to the artificial development of Hexi corridor. It is thus not surprising the downstream areas underwent desertification and eventually turned into a desert.

**Keywords:** Ancient oases, Han Dynasty, desertification, agriculture

# HEALTH CARE AMONG AN EARLY MEDIEVAL COMMUNITY IN ITALY (SELVICCIOLA, 4TH-8TH CENTURIES CE)

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Caring practices provided to diseased individuals in past populations are of interest in bioarchaeology, with increasing literature describing community effort in the provision of care. The skeletal series from the Late Antique/Early Medieval cemetery of Selvicciola (Latium, Italy), included an elderly woman who revealed heterotopic ossification and ankylosis of the left hip. The extensive bone remodelling deformed the acetabulum, locking the femoral head within the joint. This caused a reduction in abduction/adduction movement of the leg and extended eburnation on the joint surfaces of the knees. The cervical vertebrae, the only preserved, were affected by severe osteoarthritis. The presence of large osteophytes on the bodies of the first five vertebrae were indicative of acute pain and a likely reduction in movement. To assess the effect of ankylosis of the left hip and related mobility, we applied morphometric maps of cortical thickness to both tibia and femur. Diet reconstruction by stable carbon and nitrogen isotopes analysis reveals a protein intake coherent with that of the other individuals analyzed from the Selvicciola necropolis (n=33). Our investigation suggests that for several years this woman had difficulty moving, and a progressive worsening of her condition resulted in her becoming highly dependent on other people. Her condition could not heal, nor a cure could be provided, nonetheless the community took care of her. The combination of paleopathological, bioarchaeological and historical data allowed us to reconstruct an osteobiography of this elderly woman, which speaks of health care as a significant part of community life in the past.

**Keywords:** Heterotopic ossification, ankylosis, osteobiography, limping, Longobards, diet

# A POSSIBLE CASE OF DEVELOPMENTAL DYSPLASIA OF THE HIP IN THE WEST HAN DYNASTY, CHINA

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Developmental dysplasia of the hip (DDH) refers to a wide spectrum of conditions of hip joint abnormalities, which are often seen in infants and young children nowadays. With the prevalence of DDH varying across the regions, China generally has a prevalence lower than 2%. And when it comes to archaeological contexts in China, there is no official report of DDH. This case study presents a potential case of DDH in ancient China. Dating back to the Western Han Dynasty (202 BCE-8 CE), the specimen of interest, coded as M142, is from Dabaozi Cemetery, Jingyang County, Shaanxi, China. M142 is a male adult with an estimated height of 150.67 cm. He presents obvious pathologies on the left acetabulum. A false acetabulum formed in a rounded cup shape. Meanwhile, the contour of the joint had changed with the presence of eburnation and grooving, indicating a severe form of osteoarthritis. The porous surface and lytic lesion are suggestive of necrosis. The left femoral shaft showed a great reduction in circumference. Knee valgus was also observed in M142, which probably resulted from the unilateral DDH. It is likely that M142 had DDH due to the application of swaddling, and he received temporary care from his family and neighbors. Through this case study, we provide insights into the social welfare and caregiving practices in the Han Dynasty. Meanwhile, we hope this study could call for awareness of DDH in Chinese archaeological contexts.

**Keywords:** Developmental dysplasia of the hip, bioarchaeology of care model, Han Dynasty, China

**Funding agencies:** This study is funded by Creativity and Excellence Programme and NAP Grant from Nanyang Technological University, Singapore. Both grants' recipients are Ivy Hui and Yuan Yeh.

# LONG-TERM CONSEQUENCES OF AN UNUNITED TIBIA FRACTURE IN AN EARLY IRON AGE INDIVIDUAL FROM NORTHWESTERN CHINA

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In 2020, a salvage excavation was conducted on a cemetery with nine burials in Bayanbulak, northwestern China, which was dated to no later than Han (202 BCE-220 CE) according to the burial types and artifacts. Except for the cranium and left fibula, most bones were complete and well preserved, belonging to a 30-40-year-old male. Macroscopic analysis revealed several pathological changes including an ununited fracture of the right distal tibia shaft. The broken ends fit together tightly, showing a large amount of fracture repair callus. The tibia had been shortened, while the distal broken end had displaced posteriorly with some reversion to form a pseudarthrosis. The contact surfaces of the two ends were remodelled, with a porous structure and scattered sclerosis, indicating an inflammatory response. Based on this appearance a diagnosis of hypertrophic non-union is warranted. The right distal fibula also shows contour deformity, likely indicating a healed oblique fracture. It was hypothesized that insufficient fixation of the fracture led to the formation of a pseudarthrosis on the tibia. This individual also had healed fractures on his left mandibular ramus and sternal right 5th and 6th ribs. Osteoarthritis of his distal right radius and capitata could be indicative of unilateral cane use, while enthesal changes on his right tibia and fibula indicate that he was still mobile after the injury. The archaeological research of the site is currently in progress; radiography and CT scanning will be conducted in the future to provide further insights into the life of this individual.

**Keywords:** Trauma, hypertrophic non-union, healing complication



















23rd Paleopathology Association European Meeting. Abstract Book. –  
Vilnius: Vilnius University Press, 2022. – 192 p.

ISBN 978-609-07-0757-9 (print book)

ISBN 978-609-07-0758-6 (digital PDF)

<https://doi.org/10.15388/23rdPalAssocEuropMeeting.2022>

Designer Jurga Tėvelienė

Layout by Nijolė Bukantienė

Published by Vilnius University Press

Saulėtekio al. 9, LT-10222 Vilnius, Lithuania

[info@leidykla.vu.lt](mailto:info@leidykla.vu.lt), [www.leidykla.vu.lt](http://www.leidykla.vu.lt)

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[Mokslo.periodikos.zurnalai.zurnalai.vu.lt](http://Mokslo.periodikos.zurnalai.zurnalai.vu.lt)

Printed UAB „Baltijos kopija“

Kareivių g. 13B, LT-09109 Vilnius, Lithuania

Copies 130 egz., 8,6 author's sheet

