BABAO 21st ANNUAL MEETING
2019
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Welcome

The organising committee welcomes you to the 21st Annual Conference of the British Association for Biological Anthropology and Osteoarchaeology here at the Natural History Museum. We are delighted to be hosting the conference this year, and hope you enjoy the weekend’s talks and posters.

Organising Committee:

Dr Heather Bonney
Nichola Arthur
Prof Ian Barnes
Dr Silvia Bello
Dr Selina Brace
Alison Freyne
Linzi Harvey
Dr Louise Humphrey
Dr Rachel Ives
Dr Karen Swan
Jennifer White
**Venue Information**

- **NHM Staff Entrance**
- **Eastside Restaurant and Bar**
- **The Rembrandt Hotel**

**Getting here**

Underground: South Kensington Tube Station is the closest underground station – approximately 5 minutes’ walk – and is served by the District, Circle, and Piccadilly lines.

Buses: Routes 14, 49, 70, 74, 345, 360, 414, 430 and C1 stop close to the Museum.

Car: There are limited drop-off points near the Museum, no parking is available on site.

Accessibility: Please note, South Kensington Tube Station is not step-free. Gloucester Road station is approximately 7 minutes’ walk from the Museum and has step-free exit from the Piccadilly Line. There is a step-free exit, and interchange between the District/Circle and Piccadilly lines at Earl’s Court. There is an accessible bus stop at Harrington Road. Please visit the TfL and NHM websites for further accessibility information.
Joining instructions

Please enter via the Exhibition Road Staff Entrance and say that you are attending BABA0 2019. Staff will be on hand to guide you to the Flett Lecture Theatre, where the podium sessions will be held. Posters will be exhibited in the Flett Theatre Foyer and can be viewed from Saturday morning until the conference closes. Refreshments will be served in the Flett Theatre Foyer during the Tea Breaks.

The drinks reception on Friday evening will be held at Eastside Restaurant and Bar, Imperial College London, SW7 2AZ.

The conference dinner will be held at The Rembrandt Hotel, Knightsbridge, SW7 2RS.

We will be open for registration from 12:00 on Friday 13th September, and attendees may arrive from 9:00 on Saturday 14th and Sunday 15th. Please note that, due to museum opening hours, the venue will close and we will be asked to leave by security at 17.30. We would be grateful if everyone could help us stick to time.

Please note that Lunch is not provided on the Friday.
Important Information

Social Media and Sharing
This conference will operate on an ‘open by default’ basis with regard to social media; i.e. attendees may discuss the content of presentations on Twitter etc. unless the presenter makes a request for them not to do so. However, we are asking that photographs of slides are not shared unless the presenter has given specific permission to do so. At the beginning of your talk, please indicate if you prefer the content of your presentation not to be discussed (e.g. due to unpublished data under embargo), and whether you are willing for people to share images of your presentation.

Code of Conduct
Please take a minute to read the Code of Conduct in the next section (also on the conference website at https://www.babao.org.uk/conferences/babao-annual-conference-2019/). If your presentation contains material that some people may find distressing (e.g. discussion or images of forensic casework), please include a content warning on your opening slide. Please take particular note of the Social Media policy for this meeting:

1. Please do not share, or post photographs of presentation slides to social media unless the presenter has given specific permission to do so.

2. Whilst broadcasting conferences via social media is generally an accepted and important part of academic meetings, this is a private event and some presenters may request that their content is not discussed or posted publicly (this could be for several reasons, e.g. embargoed data that hasn’t yet been published, or sensitive material), this should be respected.

3. Intimidation or harassment of any kind via social media is unacceptable.

Presenters
Speakers: Please bring your Powerpoint/slides to the registration desk during the break prior to your session. Our AV team will be running these on a Windows PC so please ensure that it is compatible. Presentations should be 12 minutes long with up to 3 minutes of questions. Please note that due to time constraints, presenters will be stopped at 12 minutes to prevent overrunning of the programme.

Poster presenters: Please bring your posters on Saturday morning as we cannot leave any items in the venue overnight on Friday due to another event. We will provide Velcro for putting up posters. Please make a note of your poster number in this programme, and use the corresponding numbered board.

Posters will be on display from the Saturday until the end of the conference. You are welcome to stand by your posters at any time, but you are particularly invited to stand by your posters from 13:00-14:00 on Saturday.
BABAO 2019 Annual Meeting Code of Conduct

By registering for the conference, you acknowledge that you have read and understood this document, and that a breach of this Code of Conduct may result in your registration being rescinded without refund, and refusal of admittance to the conference venue.

Academic conferences are an important part of our professional lives and provide a valuable opportunity to present and hear about research, and to network with colleagues in a social setting. It is essential, however, that those attending do so in a safe and managed environment. This code of conduct applies to all events related to the conference both at and away from the conference venue, including the welcome reception and conference dinner in addition to the scientific sessions and breaks.

1. Attendees should not engage in any form of bullying or harassment toward any other attendee. Harassment is defined as unwanted conduct that undermines someone’s dignity or creates an intimidating and hostile environment. It may be related to sex, gender, origin, disability, sexual orientation, religion or beliefs, age, or other personal characteristic. Examples include, but are not limited to:
   a. Use of offensive or insulting language
   b. Suggestive gestures, remarks, innuendo, unwelcome terms of endearment or sexual advances
   c. Displays of sexually suggestive or pornographic objects or images
   d. Unnecessary unwanted body contact
   e. Discussion of malicious rumours or unfounded allegations
   f. Threatening language or behaviour

2. Do have a drink if you’d like to, but please do so in moderation and remember that you are in a professional environment and that acceptable standards of behaviour remain the same regardless of the consumption of alcohol.

3. Presentations should not be interrupted or disrupted by, e.g. repeated mobile telephone noise, audible conversation or comments.

4. Questions to presenters should be respectful and not be presented in a belittling or demeaning manner.

5. Presenters should give content warnings if their presentation contains material likely to be deemed distressing (e.g. images containing substantial amounts of soft tissue, or discussion of specific events that may have impacted attendees. Given the nature of BABAO, it is assumed that many presentations will contain images of skeletal human remains, and attendees should recognise that content warnings will not be given for these).

6. Attendees should not behave in any way that could bring the name of the Association into disrepute.

7. The use of illegal drugs is strictly forbidden.
Social Media

1. Please do not share, or post photographs of presentation slides to social media unless the presenter has given specific permission to do so.

2. Whilst broadcasting conferences via social media is generally an accepted and important part of academic meetings, this is a private event and some presenters may request that their content is not discussed or posted publicly (this could be for several reasons, e.g. embargoed data that hasn’t yet been published, or sensitive material), this should be respected.

3. Intimidation or harassment of any kind via social media is unacceptable.
Programme Overview

**Friday 13th September**

12:00-13:00   Registration opens
13:00-13:15   Welcome
13:15-14:30   Session 1: Dental Bioarchaeology
14:30-15:00   Tea Break
15:00-16:45   Session 2: Open
18:00 onwards   Evening Drinks Reception

**Saturday 14th September**

9:00   Open
9:30-10:45   Session 3: Funerary Archaeology
10:45-11:15   Tea Break and Posters
11:15-12:30   Session 4: Forensic Anthropology/Archaeology
12:30-13:30   Lunch and Posters
13:30-14:30   BABAO AGM and Posters
14:30-15:45   Session 5: Palaeopathology
15:45-16:15   Tea Break and Posters
16:15-17:30   Session 6: Populations & Diversity
19:00   Conference Dinner and Quiz

**Sunday 15th September**

9:00   Open
9:30-10:45   Session 7: Activity & Biomechanics
10:45-11:15   Tea Break and Posters
11:15-12:00   Keynote Speaker: Jane Sidell “The London Dead: Resurrection”
12:00-13:15   Session 8: Progress & Futures
13:15-13:45   Prizes and close of conference
Session Programme  
Friday 13th September

12.00-13.00 Registration

Session 1: Dental Bioarchaeology
Chair: Louise Humphrey

13:15-14:30 Chair’s Introduction

Barbara Veselka, Brickley MB, D’Ortenzio LL et al.
Demystifying the dentine: micro-CT assessment of dental mineralisation defects indicative of vitamin D deficiency in two 17th – 19th century Dutch communities

Rebecca Whiting, Antoine D, Hillson S
Investigating dental wear from the Neolithic to medieval, in the Middle Nile Valley, Sudan

Hannah Koon, Armit I, Beaumont J et al.
An isotopic investigation of probable infantile scurvy using incremental sampling of deciduous dentine

Christianne Fernee, Robson Brown, K, Zakrzewski S
Like pulling teeth: variation in dental tissues within and between individuals and populations

14:30-15:00 Tea Break

Session 2: Open
Chair: Selina Brace

15:00-16:30 Chair’s Introduction

Yuka Shichiza
The repatriation of Ainu human remains: The role of archaeologists and anthropologists

Tom Booth, Diekmann Y, Thomas M et al.
Why were 17 people buried in a well in 12th century Norwich? Radiocarbon dating and genome-wide analysis of medieval human remains from Chapelfield, Norwich, UK

Nicole Torres-Tamayo, Lois-Zolniiski S, Palancar CA et al.
Reconstructing the lumbar spine morphology of extinct hominins: A quantitative 3D approach

Madeline Robles, Morgan R, Rando C
The utility of three-dimensional models of paranasal sinuses to establish age, sex, and ancestry across three modern populations

Withdrawn

Evening Drinks Reception
18:00 Eastside Restaurant and Bar, Imperial College London
Saturday 14th September

Session 3: Funerary Archaeology
Chair: Rebecca Redfern

9:30-10:45 Chair’s Introduction
Louise Humphrey
Later Stone Age burials from Grotte des Pigeons at Taforalt
Lisa Monetti
Interpretation of funerary practice through fracture pattern analysis of cremated human remains: A pilot study
Sharon Clough
Mystery of the Cannington Cave bones – Solved!
Rachel Ives
“Funerals got up in this style” – burial practices in a mid-19th century privately-owned ground from Bethnal Green, London

10:45-11:15 Tea Break and Posters

Session 4: Forensic Anthropology/Archaeology
Chair: Carolyn Rando

11:15-12:30 Chair’s Introduction
Mária Putško, Štuller F, Krajčovič J
The issue with burned human remains in a forensic context: example of a serial killer from Slovakia
Caterina Raffone, Lambacher N, Herrasti L
A revised method and new application form for a standardised assessment of the preservation state of human remains: Implications for both forensic and archaeological contexts
Jo Appleby, Lemmers S, Gonçalves D et al.
Burned fleshed or dry? The potential of bioerosion to determine the pre-burning condition of human remains
Daniela Tumler, Zink A
Multiple perimortem sharp force trauma in an individual from the early medieval cemetery of Säben-Sabiona in South Tyrol, Italy

12:30-13:30 Lunch
13:00-14:00 Posters
13:30-14:30 BABAO AGM
Session 5: Palaeopathology
Chair: Mary Lewis
14:30-15:45  Chair’s Introduction
Anna M. Davies-Barrett, Roberts C, Antoine D
Respiratory disease in the Middle Nile Valley: the impact of environmental and sociocultural change from the Neolithic to medieval periods
David Minnikin, Lee O, Wu H et al.
Micro-CT scanning of bison metacarpals reinforces Pleistocene zoonotic evolution of tuberculosis
Iulia Rusu, Madgwick R
Exploring Magyar diet and health: integrating osteoarchaeology and isotope analysis
Sarah Schrader
Stressed to death: an analysis of hair cortisol and non-specific stress indicators

15:45-16:15  Tea Break and Posters

Session 6: Populations & Diversity
Chair: Ian Barnes
16:15-17:30  Chair’s Introduction
Rebecca Redfern
Bioarchaeological evidence for population diversity in medieval London
Nichola Arthur, Bonney H
What the river knew: osteological analysis and new AMS radiocarbon dates for archaeological human remains from the River Thames
Efthymia Nikita, Alexander M, Carver M et al.
People in motion: tracing human mobility across the Mediterranean in the Byzantine Era
Chris Aris, Craig-Atkins E, Nyström P
Age, sex, and population genetics: influences on the accuracy of determining sex of human remains from permanent dentition

Please leave promptly after the end of this talk, as the venue will close at 17:45. Thank you.

Conference Dinner and Quiz
19:00  The Rembrandt Hotel, Knightsbridge
Session 7: Activity and Biomarkers
Chair: Heather Bonney

9:30-10:45 Chair’s Introduction
Emma Saunders, Márquez-Grant N, Zioupos P
An activity related disorder of the femur: a study into the association between cam morphology and femoral non-metric traits
Nivien Speith
When biomechanics isn’t everything: towards comprehensive palaeopathological approaches to identifying neurodegenerative disorders
Karen Swan, Ives R, Wilson L, Humphrey L
Femoral cross-sectional geometry and locomotor development in children from post-medieval London
Michael Rivera
Coastal lifestyles and limb biomechanics among prehistoric Baltic groups between 9,000 BCE and 1,200 CE

10:45-11:15 Tea Break and Posters

11:15-12:00 KEYNOTE SPEAKER
Jane Sidell
‘The London Dead: Resurrection’.

Session 8: Progress & Futures
Chair: Tim Thompson

12:00-13:15 Chair’s Introduction
David Errickson, Giles S
Human taphonomic facilities: a forensic practitioner focus
Patrick Randolph-Quinney, Houldsworth P, Cross P
From pigs in buckets to body farms: the need for experimental and analytical standardisation in human and non-human forensic taphonomic research
Mary Lewis
Growing-up and branching out: principals and potential of child palaeopathology
Tamsin O’Connell
Isotopic analyses in bioarchaeology: eyeballing and handwaving?

13:15-13:45 Prizes and close of conference
After realizing at the age of 8 that I wanted to be an archaeologist, I was lucky enough to study archaeology at Verulamium Museum, learning about the subject and how to dig before taking a couple of degrees at the Institute. I started as a Romanist, moving rapidly across to science, whilst taking every opportunity for fieldwork, being lucky enough to work with Institute staff in Sparta and Leptis Magna for many seasons. Heading out to work at the Museum of London gave me a love of London's archaeology, which is surprisingly well-preserved and rich in time depth and complexity. London is compact enough to allow me to study it as a coherent landscape which formed the basis of my PhD at Durham University, focusing on sea-level rise and the impact of the changing Thames on the human population. However, London also has been home to a huge diversity of cultures, inhabitation patterns and events. So here I have stayed, as environmental archaeologist for the Museum of London, then science advisor and research fellow at the Institute of Archaeology where I was lucky enough to teach an MA in the Archaeology of London. Currently, I am Inspector of Ancient Monuments for Historic England, where it is my joy to help protect those archaeological sites considered the finest examples of our shared past.
Burned fleshy or dry? The potential of bioerosion to determine the pre-burning condition of human remains.

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Aims and objectives

The length of the interval between death and cremation is important for understanding past mortuary practices as well as in forensic cases, but is difficult to establish using current methods. Bioerosion has recently been interpreted as evidence of bodily putrefaction and decay. This research aimed to discover whether bioerosion remains visible on experimentally burned bone, potentially offering a new method to identify individuals who have died a significant time before cremation.

Materials and Methods

Femoral fragments from modern and archaeological collections of the University of Coimbra were subjected to experimental heating. Sixteen recent femur samples from eight individuals, and five femur samples from an archaeological skeleton from the medieval-modern cemetery at the Hospital de Santo António (Porto) were burnt at maximum temperatures of 300\textdegree C, 500\textdegree C, 700\textdegree C, and 900\textdegree C. Samples were examined for histological indications of bioerosion, which were compared with unburned samples from the same individual.

Results

Bioerosion remained visible histologically even in bones burnt at high temperature. The highest level of bioerosion was in the archaeological sample. Modern samples showed low levels of bioerosion, even though these individuals had been buried for at least three years. This may be due to the action of a decomposition accelerator used at the modern cemetery.

Discussion

Bioerosion lesions in histological thin sections of burned bone can be used to interpret pre-cremation body treatment, with potential application in archaeological and forensic contexts. However, the effects of substances such as bacterial- or enzymatic-based products used to accelerate decomposition, should be investigated.
Age, sex, and population genetics: influences on the accuracy of determining sex of human remains from permanent dentition.

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Accurate methods for sex determination of human remains are of great value to the fields of archaeology and forensic anthropology. Our recent project (BABAO academic research grant supported), investigated the utility of using first upper permanent maxillary molars to determine sex through discriminant analysis of linear measurements. Molars of 91 adults (19-55 years) and 58 immatures (5-18 years) from the known-sex Spitalfields crypt collection were examined. The cross-validated results of the discriminant function correctly determined the sex of 94.6\% of adults. The accuracy of the same equation applied to immatures was 90.9\%. The function was marginally more accurate in sexing females (95.3\%) compared to males (93.3\%). In order to test whether the accuracy of the method also varied between populations it was replicated on the Anglo-Saxon Black Gate collection. Only 83.9\% of males and 82.6\% of females were assigned sex consistent with skeletal analyses. These results show the utility and potential of using permanent molars to sex human remains. However, they also identified accuracy bias of varying degrees according to age and sex, and variations between populations. As a result, while sexing methods based on permanent dentition are accurate, an appreciation as to how sexual dimorphism can vary both between and within populations is needed. Discussion of these factors is pertinent now as similar methods continue to be developed.
What the river knew: osteological analysis and new AMS radiocarbon dates for archaeological human remains from the River Thames.

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Hundreds of archaeological human remains, predominantly crania, have been recovered from the London reaches of the River Thames over the last two centuries. Previous academic debate has focused on whether the accumulations of crania reflect ritual relationships between prehistoric peoples and water, or taphonomic processes. An ongoing multi-disciplinary project, combining new radiocarbon, isotopic, genetic and osteological data, aims to provide novel insight into the riverine deposition of the Thames remains. Here we present the results of the AMS radiocarbon dating programme, alongside the first full osteological examination of the assemblage (e.g., completeness/preservation, sex, age-at-death, pathology and trauma). Thirty-two new radiocarbon dates were obtained, effectively doubling the number of radiocarbon-dated Thames individuals (total n=61). These dates confirm the presence of a multi-period assemblage, ranging from the Neolithic to Post-Medieval periods, but with a peak in the Late Bronze to Iron Ages. Osteological analysis of over 250 individuals has revealed various patterns, including: a pronounced male sex bias, the presence subadult individuals, and a much higher prevalence of cranial trauma than previously identified. Patterns of cranial trauma are of particular interest, given the direct insight they may provide into the circumstances surrounding the riverine deposition of the remains. These new data indicate the presence of multiple forms of deposition along the length of the London Thames, through time and geographical space.
Why were 17 people buried in a well in 12th century Norwich? Radiocarbon dating and genome-wide analysis of medieval human remains from Chapelfield, Norwich, UK.

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Archaeological investigations by Norvic Archaeology in 2004 at the future site of the Chapelfield shopping centre in Norwich, UK discovered a disarticulated and comingled assemblage of six adults and 11 children that had been deposited in a well shaft near the Jewish Quarter of the medieval city. Stratigraphic analysis, radiocarbon dating and pottery typology suggested that the bodies had been buried over a short period of time in 12\textsuperscript{th}-13\textsuperscript{th} Centuries AD. This was a time of escalating violence towards Jewish communities in British cities, and it was hypothesised that individuals deposited at Chapelfield were victims of an anti-semitic attack. However, beyond perimortem cranial fractures that could have occurred at the point of deposition, there were no detectable signs of trauma on the Chapelfield bones. Possible alternative explanations for this unusual depositional event include a local epidemic, famine or a divergent form of funerary treatment afforded to certain individuals because of their economic, social or religious circumstances.

Here we present further radiocarbon dating and new genome-wide data from the Chapelfield human remains. When radiocarbon dates are combined the posterior density estimate is distributed around 1190 AD, the date of a historical anti-semitic pogrom in Norwich. Genome-wide data from three individuals show they share affinities with contemporary Ashkenazi Jewish and Southern European populations, consistent with what we would expect from individuals associated with the historical diaspora of endogamous Jewish communities. The best explanation for this data is that the adults and children recovered from Chapelfield were victims of the 1190 Norwich pogrom.
Mystery of the Cannington Cave bones – solved!

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When skeletal remains were recovered from a cave in Somerset in the 1960s they were assumed to be from a Roman to post–Roman cemetery nearby. They were recorded and then returned to the museum where they languished for over 40 years. Work by Cotswold Archaeology on the Cannington by-pass re-ignited interest in the Cannington cemetery and subsequently the bones from the cave. A grant from BABAO has allowed radiocarbon dating on the bones and re-analysis of the skeletal remains. Both the radiocarbon dates returned as early Mesolithic, confirming these were in fact not from the cemetery, but likely to be cave burials. Research into the British Mesolithic funerary tradition and skeletal evidence confirms that these are a rare and exciting new find. Extending the number of confirmed Mesolithic burial sites and increasing the quantity of human remains from this period. An overview of the site, osteology of the bones and the context within the British Mesolithic will be presented.

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Respiratory disease in the Middle Nile Valley: the impact of environmental and sociocultural change from the Neolithic to medieval periods.

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In human skeletal remains, inflammation caused by respiratory disease can be detected by the presence of new bone formation in the sinuses (sinusitis) and on the inner surfaces of the ribs (lower respiratory tract disease). While many factors influence the prevalence of respiratory disease, particulate pollution plays a major role in inflaming the respiratory tract, increasing susceptibility to respiratory conditions and infection. Thus, evidence for respiratory disease in human skeletons from archaeological populations can provide a past perspective on exposure to particulate pollution and infectious pathogens from various environmental and sociocultural sources.

Evidence for respiratory disease was recorded in thirteen cemetery sites from the Middle Nile Valley, ranging from the Neolithic to Medieval periods (5000 BC – AD 1500). All available maxillary sinuses and inner surfaces of the ribs were analysed in a total of 563 human skeletons. Results demonstrate an increase in the prevalence of respiratory disease between the Neolithic and later time periods. Among the highest prevalence rates were found in the urban Medieval site.

In Sudan, increasing aridity from the Neolithic period until the modern day may have led to a growing exposure to environmental particulate matter from airborne dust and sand. Additionally, the impact of agricultural intensification, increased population density, disease load, and craft specialisation, particularly in urban environments, all likely affected the increase in prevalence rates observed in the Middle Nile Valley. Currently, arid and urban environments are expanding globally. Thus, this research provides a unique past perspective to a problem of increasing concern today.
Human taphonomic facilities: a forensic practitioner focus

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The development of research decay facilities such as the University of Tennessee’s famous “Body Farm”, has now made it possible to observe taphonomic events and acquire evidence-based explanations before formulating PMI estimation theories. However, the vast majority of experimental research studies have used such facilities as a means to test predictions, consistent with deductive reasoning. Experiments are often unsystematically constructed and reduced to observe the effects of exposure to a single variable in question, often using very small porcine sample sizes when human remains are not available, which arguably questions the applicability of the results to forensic practice. Ultimately, it has gone unnoticed that a huge body of decomposition data sits within retrospective case studies and photographs in UK Police Forces. Such archives hold photographs of cadavers both at the scene and in the mortuary, alongside case notes containing circumstantial evidence surrounding the death. Ultimately, thousands of cases can be generated and subject to statistical evaluation which may provide an alternative, more applicable means to inform our understanding of the PMI and decomposition in the forensic disciplines. In turn, this can be used to assist experimental approaches at human taphonomic facilities in conjunction with police-led questions and training. This approach can also lead to an improved development of methodological approaches focussing on decomposition studies that can be useful to other disciplines such as archaeology. This presentation aims to provide an alternative viewpoint to the discussion of a human taphonomic facility in the United Kingdom while maintaining a credible forensic based focus.
Like pulling teeth: variation in dental tissues within and between individuals and populations.

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Tooth form represents a physiological response to environmental constraints, biology and cultural systems, on both an individual and populational level. Studies of between-population variation have focused largely upon samples from prehistoric contexts. Dental variation within populations and within individuals is far less well understood than variation between populations. This paper aims to investigate how dental tissues vary in size within and between individuals and populations, from historic samples.

Teeth were obtained from Anglo-Saxon (n = 100), Early (n = 100) and Late Medieval (n = 100) samples from the South of the UK. They were micro-CT scanned using a Skyscan 1272/1275 and a Nikon XTH 320, at a resolution of 17.5-65μm. Dental tissues were extracted by grayscale threshold segmentation. The crown and root were then separated along the CEJ. Volumetric and surface area measurements were obtained for each dental tissue (enamel, dentin and pulp) and tooth proportions (crown, root and whole tooth). Variation in these measurements were then analysed between populations, individuals and within individuals.

The results suggest that the Post-Neolithic period is neither a time of continued dental reduction nor stagnation. An unexpected pattern of change was identified, with an increase in size over-time. Dimorphism in dental tissues was also identified. The results also suggest that more variation occurs between individuals than first thought. These results will be contextualised by considering environmental, biological and cultural factors. The repercussions of these results on past and future research will also be discussed.
Later Stone Age burials from Grotte des Pigeons at Taforalt.

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Grotte des Pigeons, located near Taforalt in north-eastern Morocco, shows evidence of human presence from at least 110,000 years ago. An intensification of human activity 15,000 years ago broadly coincided with the first use of the site for human burials. Excavations directed by Abbé Roche during 1951-5 uncovered an extensive series of Iberomaurusian (Later Stone Age) burials in two areas, known as Necropolis I and II.

A new phase of archaeological investigations was initiated to investigate the spatial and chronological extent of mortuary deposits, and their relationship to archaeological deposits elsewhere in the cave. Further aims were to explore the patterning of funerary treatment in relation to social and demographic parameters and to provide an additional perspective on the diversity of funerary behaviour among Late Pleistocene populations of the Maghreb.

Excavations revealed 13 burials including 6 infants in an alcove at the back of the cave (Sector 10). Burial features include a seated or semi-reclining body position, occasional use of ochre, placement of bodies beneath large stones, and inclusion of horn cores and other objects; but none of the burials incorporated all of these features. Intensive re-use of deposits and close spatial proximity had caused truncation of some burials and secondary re-deposition of disturbed skeletal elements, but in contrast to the Roche series, there was no unequivocal evidence for deliberate manipulation or removal of skeletal parts. Sector 10 and Necropolis I and II formed a collective burial area that was separate from areas of the cave used for occupational activities.
“Funerals got up in this style” Burial practices in a mid-19th century privately-owned ground from Bethnal Green, London.

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This presentation aims to consider new research questions derived from a proposed research strategy for a better understanding of post-medieval funerary archaeology (Allen Archaeology, 2015 on behalf of Historic England) in light of evidence found during the excavation of a large mid-19th century burial ground from Bethnal Green, London, to develop insights into 19th century burial practices. The burial ground was a privately-run business venture operating between 1840 and 1855 and established within one of the poorest parishes of London at this time. Twenty-thousand burials were interred at the site during those 15 years and 1033 were archaeologically excavated in advance of development. Archaeological evidence of the deliberate management of burial space within the privately-run ground, together with historical evidence of the intended provision of burial space and funerary evidence for family burials, give insights into the attitudes towards providing space for the dead at this time. This paper also considers the value of artefactual evidence of grave memorials, coffin construction and decoration, clothing and botanical remains, in questioning attitudes towards burial provision and funerary commemoration.
An isotopic investigation of probable infantile scurvy using incremental sampling of deciduous dentine.

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This paper presents a case study from an infant, viewed against a larger isotopic and osteological investigation of an Early Iron Age skeletal assemblage from Slovenia. Osteological analysis of the infant identified pathological lesions including abnormal porosity and bone growth consistent with malnutrition and phases of recovery. The distribution and appearance of these pathological lesions led to the conclusion that this infant probably suffered from scurvy (vitamin C deficiency). Incremental dentine isotope analyses provided a high-resolution record of dietary and metabolic change from pre-birth to around the time of death. The isotope data exhibited unusually high δ¹³C values for this region and time period (between -11.3‰ and -12.6‰), while δ¹⁵N values were observed to be c. 3‰ above that of rib collagen sampled from contemporary adults recovered from the same site. The osteological and biomolecular evidence supports the hypothesis that this infant suffered from severe malnutrition and an increasingly negative nitrogen balance. The paper discusses some scenarios which could have resulted in these unusual isotope ratios, whilst considering the diagnosis of possible metabolic disease. The paper also addresses the need for context when interpreting isotopic results, supporting the argument that this data should not be viewed in isolation, but rather as part of a multidisciplinary approach, considering the multiple causalities of isotopic variability.
Growing-up and branching out: principals and potential of child palaeopathology.

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Children and adolescents represent a unique subset of past populations. Their transitional status, physiologically, psychologically and culturally make them particularly vulnerable to trauma and disease, and challenges in recognising skeletal changes still exist. Recent research has advanced our diagnostic criteria for rickets, scurvy, trauma and tuberculosis, and we are becoming ever more sophisticated in the way we interpret the information they hold. We are developing a deeper theoretical understanding of the child’s life course from the womb to full maturity providing insights into their birth, development, activity and environment. This paper discusses the unique features of non-adult skeletal remains in response to disease and injuries, and the potential for further research. It ends with a consideration of the palaeopathology of adolescents and the particular story they have to tell.
Micro-CT scanning of bison metacarpals reinforces Pleistocene zoonotic evolution of tuberculosis.

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Aims and Objectives Characteristic metacarpal lesions “undermining the articular surface” indicate tuberculosis in Pleistocene megafauna. Lipid and DNA biomarkers confirmed the presence of tuberculosis in such a lesioned 17ka bison from Natural Trap Cave, Wyoming. In unpublished work, tuberculosis lipid biomarkers were found in a lesioned 40ka bison metacarpal from Kent’s Cavern, Torquay and 12ka mastodon metapodials from Buffalo, NY. The aim was to subjectively search for characteristic lesions in a wide range of Pleistocene bison metacarpals and objectively use micro-CT scanning (Natural History Museum) for confirmation.

Methods and Results External lesions were clearly seen in bison metacarpals from Idaho (30ka), Rotterdam North Sea (37ka), Isleworth (50ka), Barrington (80ka), Wretton (80ka), Shropham (120ka) and Joint Mitnor Cave (120ka). In representative cases, micro-CT scanning revealed internal cavities that correspond precisely with external lesions. In particular, specimens from Idaho (30ka), Rotterdam (37ka) and Shropham (120ka) had internal spherical cavities (2-3mm diameter) that were confirmed by dissection.

Discussion Present results reinforce the hypothesis that tuberculosis evolved as a non-lethal zoonosis in a range of Pleistocene megafauna before becoming more virulent due to increased hydrophobicity and consequent aerosol transmission. In the late Pleistocene, newly virulent tuberculosis may well have decimated herds of megafauna and contemporary mammals, precise dates being influenced by geographical and climatic factors. Before the beginning of the Holocene, naïve H. sapiens, settling in the Fertile Crescent, could well have contracted virulent tuberculosis from declining megafaunal populations, leading to the onset and upsurge of the modern disease.
Dentoalveolar diseases and dietary habits of the Italian Renaissance upper classes: the Guinigi family from Lucca (Italy, 14th-17th centuries AD).

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**Aims and objectives** Dentoalveolar pathologies reveal to be very informative when studying health conditions and dietary behaviors in ancient populations. The purpose of this research is to investigate the oral conditions and dietary habits among the social upper classes of the Italian Renaissance.

**Material and methods** Archaeological investigations carried out in the S. Francesco Monastery at Lucca (Tuscany, Italy) unearthed the burials of the Guinigi, a powerful family of traders and bankers. The commingled skeletal remains of about 150 individuals belonging to the family were found buried together in two large collective stone tombs used between the 14\textsuperscript{th} and the 17\textsuperscript{th} centuries AD. 98 adult skulls were selected and caries, abscesses, alveolar resorption, and ante mortem tooth loss have been observed in 1959 alveoli and 786 teeth.

**Results** The prevalence of all dentoalveolar diseases is extremely high, especially dental caries is extraordinarily widespread, and more than the half of the sample is affected by periodontitis.

**Discussion** A comparison between the Guinigi and other Italian samples was performed. The skeletal series characterized by a rural economy show lower frequencies of dental pathologies, while the élite series have significantly higher frequencies. Among these, the Guinigi family results to be the most affected. This phenomenon can be linked to several factors, including an increased longevity among the aristocrats and differences in food availability. The banquets of aristocratic Renaissance families were enriched with refined foods, including sweet foods that might justify the high frequency of caries among the nobles, and especially in the Guinigi.
Interpretation of funerary practice through fracture pattern analysis of cremated human remains: a pilot study.

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By reconstructing the practical and ritual acts of a funeral, a better understanding of how the living interacted with the dead can be realised. Cremated human bone is an abundant resource in the archaeological record, and with proper analysis, can contribute to the understanding of all stages of the funerary process. This project identifies differential burning on the skeleton through novel analysis of fragment shape and size as well as fracture patterns. All measurements (area, circularity, maximum length, solidity, and fracture patterns) are analysed by group (bone, bone type, skeletal regions, side, burial, site, and site type) to identify patterns or variations that may have been caused by funerary practice. This research also takes into account other possible causes of fragmentation and fracturing, particularly taphonomic agents, when assessing these attributes.

A pilot study analysing over 3000 fragments has been conducted, and trends are emerging, one perhaps suggesting arm position of the deceased on the pyre. This presentation will discuss the results thus far and further describe the plan for the continuing interpretation of the funeral, including the use of experimental cremation and analysis. While this project attempts to expand understanding of funerary customs in the context of Roman Britain, this thorough analysis will also contribute to a baseline understanding of the expected fracture patterns observed on cremated bone. This method focuses on the use of osteological remains, rather than grave goods for interpretation of funerary rituals and behaviours as the latter can be misleading or limited in cremation burials.
People in motion: tracing human mobility across the Mediterranean in the Byzantine era.

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*People in Motion* explores human mobility across the Mediterranean during the Byzantine period with a focus on the 5th to 11th centuries. Human mobility played a key role in the formation of the multi-ethnic Byzantine state and *People in Motion* is the first project to systematically examine the scale, nature, and impact that migration had on those who relocated and on the local communities in the lands they inhabited based on the most direct evidence of these individuals, skeletal remains. The project encompasses material from Tunisia, Italy, Greece and Cyprus. Human mobility is explored using a combination of macroscopic (dental nonmetric traits), microanalytical (dental calculus microdebris analysis), and biochemical (strontium isotope analysis) methods. The project is at the stage of intensive data collection, but our combination of different methodological approaches is anticipated to elucidate mobility from the level of the individual to that of broader human groups. In particular, dental nonmetric traits will reveal the extent of gene flow between different Mediterranean groups. The microscopic study of dental calculus will identify nonlocal dietary and occupational microdebris, pointing to individuals who either arrived from a different region or local people who consumed imported goods. Finally, the strontium isotope analysis will identify whether the aforementioned individuals were indeed of a local or nonlocal origin. Given the worldwide trend towards closing borders, this project is expected to increase public awareness regarding the antiquity of migration and its role in shaping modern identities.
Isotopic analyses in bioarchaeology: eyeballing and handwaving?

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Isotopic analysis as a method of assessing diet or geographical origin is now ubiquitous in (bio)archaeology, to the point where seemingly no project is complete without it. The relative ease of sample preparation and increasing prevalence of isotope mass specs has contributed to its rapid growth. Yet despite its ease of execution, it is not a cut-and-dried technique, and data interpretation can be complex. The greater use by specialists and non-specialists has resulted in studies that range from excellent to dubious, from groundbreaking to mundane, even banal. Only greater understanding of the strengths and limitations of such analyses can improve the overall quality of work in this field.

The technique is often used with the aim of “reconstructing” an individual’s diet or origin. The basis for a “reconstruction” is often more flimsy than people like to admit, with a number of significant unknowns (e.g. diet-to-tissue offsets). Quantitative data are typically interpreted in a (semi)qualitative way, based on untested assumptions.

In this paper, I will outline the technique’s scope, identify some key assumptions as well as pitfalls and problems, and cover some of the common misconceptions in how the method is applied. I aim to provoke serious reflection on what we are doing well, and how isotopic studies could and should be improved.
The issue with burned human remains in a forensic context: example of a serial killer from Slovakia.

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Fire as a mean of body disposal in murders is quite rare in Slovakia. Such remains are hard to identify and even harder to find without skilled investigator or expert from the field of forensic medicine present in situ. This presentation aims to explain the issue with completely burnt human skeletal remains in forensic context, using the example of a case study of a Slovak serial killer. The murderer disposed of his victims’ bodies by firstly cutting the remains into several parts and then burning them in barrels. The remains were afterwards mixed with animal remains and dispersed in the murderer’s private garden. The analysis and identification of burnt skeletal human remains itself is difficult, and this case was further complicated by incorrect body retrieval. Unskillfulness in body retrieval methods, as well as confusion regarding who should be performing the analysis, almost led to lack of sufficient evidence needed for the murderer’s prosecution. Every skeletal remains from forensic context in Slovakia are examined by legal medicine doctors, who might not be skilled in the field of forensic anthropology. Luckily, in this case, the analysis itself was conducted in the laboratory of the Institute of Forensic Medicine in Martin by the authors, where it was undertaken as part of an “expert opinion counsel”, with collaboration from an anthropologist. This collaboration led to the collection of useful evidence, which could be used to further prosecution. In summary, this case study is a powerful example of how important is to consult the specialists.
A revised method and new application form for a standardised assessment of the preservation state of human remains: Implications for both forensic and archaeological contexts.

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The taphonomic condition of human remains is assessed widely with subjective terminology relating to the quantity of a skeleton found and the quality of the bones recovered. Here we present a revised method that allows for a more standardised and objective approach. We have tested this new technique on a forensic sample originating from a cemetery and presenting a diverse sample of preservation in the Basque Country (Northern Spain). The method allows for an objective approach to the calculation of quantity, using the recording of distinct landmarks visible on bones and used in the calculation of the

Minimum Number of Individuals (Mack et al. 2015) in combination with a statistical approach, whereas the qualitative evaluation of human remains is carried out by using a descriptive table, accompanied by images, result of a bibliographic review (BWS = bone weathering stages 0 to 4) (Behrensmeyer, 1978; Lyman and Fox, 1989; Tuross et al., 1989; Cutler et al., 1999; Todisco and Monchot, 2008).

We discuss the method’s potential to provide a standardised method to relate the preservation state of the remains useful for comparison studies in an archaeological context and/or for further forensic analysis such as genetics.
From pigs in buckets to body farms: the need for experimental and analytical standardisation in human and non-human forensic taphonomic research

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Forensic taphonomy is the science of post-mortem processes applied to a medico-legal context. Much research takes place at human or animal-based outdoor facilities, colloquially known as ‘Body Farms’. The last three decades have seen the development of a number of such facilities globally, using both human and non-human cadavers. However, much research, particularly dealing with decomposition or entomology, often takes place using ad-hoc collected animal material in informal settings with implications for experimental results and biosecurity. Across the spectrum of taphonomic facilities the discipline suffers from a lack of standardisation in methodological approaches, analytical protocols, and more importantly, from a profound lack of theoretical and epistemological basis on which to address fundamental taphonomic questions. This presentation delivers a meta-analysis of research undertaken at Taphonomic Research Facilities in order to understand historical and current trends in their use. It also aims to contextualise their use and output at a global level using standard academic metrics of research impact and significance. Findings indicate that by standard academic measures taphonomic research facilities have some academic impact, but that this is significantly less than many other areas of forensic research such as DNA or anthropology. This paper discusses the underlying reasons for this lack of impact and situates the argument in the light of the lack of standardisation in methodologies and high-level analyses. The paper highlights the need for scientific credibility in Body Farms, with a focus on rigour, repeatability, accuracy, reliability and scientific experimentation that is underpinned by robust statistical validity.
Bioarchaeological evidence for population diversity in medieval London.

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Our study is the first bioarchaeological investigation of population diversity in Medieval London. It combines macromorphoscopic trait data for ancestry, with stable isotope and aDNA results to provide new insights about some of the people who died during the Black Death between 1348-50 AD. This population were buried at East Smithfield, close to the Tower of London. Their burial ground was created specifically to respond to the pandemic’s high death toll, and so is one of the few well-dated Medieval cemeteries in Britain. Primary source evidence (wills) shows that many city dwellers chose to be buried there, but none of this evidence can be directly linked to a specific individual and no grave inscriptions were recovered. We analysed the remains of 41 individuals and established that 29% were of non ‘White-European’ ancestry1, including individuals of dual-heritage, as well as males and females with Black African ancestry. The stable isotope evidence was able to show that one of these individuals had been born in Britain, so were at least second-generation. These new data have also allowed us to revise existing osteobiographies, suggesting that possibly, at least one individual may have been an indentured servant.

1 The terms and language used are taken from forensic anthropology. We are mindful that they differ considerably to those used by Medieval historians.
Coastal lifestyles and limb biomechanics among prehistoric Baltic groups between 9,000 BCE and 1,200 CE.

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Aims and objectives Coastal populations are remarkably different from their counterparts in non-coastal environments. Riverine, lakeside and shoreline environments made fishing and foraging ideal for many past communities seeking food, even during and after transitions to agriculture. Activities associated with coastal living and agriculture can influence the shape and strength of bones in the human skeleton. Numerous studies have related subsistence strategies and bone biomechanics in other contexts, but limb bone strength and shape had not yet been diachronically studied across the Baltic Mesolithic, Neolithic, Bronze Age and Iron Age.

Material and methods This research accesses available Estonian and Latvian skeletal collections to understand diachronic patterns of activity and mobility associated with subsistence strategy among populations situated near water bodies. Cross-sectional bone segments were taken from 3D surface scans of humeri, femora and tibiae and their morphologies were analyzed across periods.

Results and discussion Data from Mesolithic (n = 7), Neolithic (n = 21), Bronze Age (n = 5) and Iron Age (n = 24) samples revealed: a) changes in subsistence strategy away from foraging lessened the physical demands acting on the humerus, b) increasingly common animal-rearing, grain cultivation and building construction led to rises in femoral and tibial robusticity, c) a reconfiguration of sexual divisions of labor was tracked through humeral cross-sections, with men taking over food acquisition tasks in later periods, and d) more sedentary lifestyles led to more circular cross-sections in the tibial shaft. Limb bone cross-sectional geometry and a ‘deep time’ approach permitted the investigation of these biological adaptation in ancient Baltic coastal populations.
The utility of three-dimensional models of paranasal sinuses to establish age, sex, and ancestry across three modern populations.

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Human identification is an essential element in any forensic investigation. However, identifications are made difficult when human remains are severely fragmented or burned. In these instances, a forensic anthropologist aims to assist law enforcement in establishing the biological profile to unknown remains using various metric and visual methods. The majority of traditional approaches employed by forensic anthropologists were developed using North American populations and therefore have shown differing accuracy rates when applied to skeletal remains outside of the United States. Complementary studies that reflect modern UK populations are needed to support new and more sophisticated methods of measurement and analysis to ultimately provide valid and robust identifications.

Researchers have quantified the variability of the paranasal sinuses between individuals and have begun to explore their ability to provide biological information. However, the literature investigating these structures in a forensic context is extremely varied and therefore the topic is not adequately addressed. The study presented here addresses this gap by employing a new method of identification using three-dimensional models of the paranasal sinuses. The models were produced from a database of modern CT scans provided by University College London Hospital (UCLH), London, UK. Analysis of 30 three-dimensional models produced from the CT data demonstrated promising variations and patterns with regards to discriminating age, sex, and ancestry. Classification rates ranged from 93% (p=.000) to 70% (p=005). The findings offer insights into the potential for using the paranasal sinuses as an attribute for establishing identification of unknown human remains in future forensic reconstruction investigations.
Exploring Magyar diet and health: integrating osteoarchaeology and isotope analysis.

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Magyar tribes settled in the Carpathian Basin at the end of the 9th century and rapidly transitioned from a semi-nomadic lifestyle to sedentism, adopting Christianity around the year 1000 A.D. Four cemeteries from Hungary and Romania, three pre-transition and one post-transition, have presented an invaluable opportunity to explore cultural, health and dietary changes between the 10th and 14th centuries, to explore the impact of this transition.

The research represents the first multi-proxy study into this transitional phase. Key questions relating to dietary variation, demographics and health of these communities were addressed using isotope and osteological analyses.

A total of 207 individuals, comprising 159 pre/peri-transition from Izvorul Împaratului, Brândești and Pîclișa and 48 from post-transition Szada were subject to δ¹³C and δ¹⁵N isotope analysis, along with 48 faunal samples to provide a dietary baseline. Results were integrated with demographic and pathological data.

Results revealed a gradual shift from a mixed and less stable C₄ based diet present within all three pre-transition cemeteries, to a homogenous C₃ diet, characteristic of the later post-conversion Szada cemetery. Similarly, some discrepancy was observed between the two sexes in the earlier (10th century) cemetery, whereas this was absent in the later (12th-14th centuries) Szada. No clear differences were observed between pathological and non-pathological individuals, suggesting that chronic dietary stress was rare.

With few cemeteries fully investigated and limited isotopic data in the region, this research represents a pioneering work into changing societies in Central-East Europe.
An activity related disorder of the femur: a study into the association between cam morphology and femoral non-metric traits.

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Poirier’s facets, plaque and cribra femoralis are extensively recorded non-metric traits of the femur. Associations between these traits and the clinical entity ‘cam morphology’ have recently been suggested. Cam morphology describes additional osseous growth at the anterior aspect of the femoral head-neck junction. It is a leading cause of femoroacetabular impingement, a painful disorder of the hip which can result in early osteoarthritis. Typically observed in young male athletes it is believed to be caused by increased loading across the joint however the aetiology is unclear. Employing quantitative assessments commonly used for the diagnosis of cam morphology to skeletal collections this research aims to determine if there is an association between these osseous traits. It also aims to determine if occupational activity is connected with their development due to the suggested aetiology. To achieve this two skeletal collections were included, an identified skeletal collection and a medieval rural collection, based on the presence of known or inferred occupational information. Measurements of proximal femoral morphology, alpha angles and offset ratios, were recorded on digital photographs in set orientations. Non-metric traits were visually graded for each femora. The results found 42.5\% of observable femora would be considered to have cam morphology and the mean alpha angle was significantly higher for those with Poirier’s facets (65.2\degree) than those without (51.0\degree) \((p<0.001)\). Limited association was found between cam morphology and occupational activity.
Stressed to death: an analysis of hair cortisol and non-specific stress indicators.

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Cortisol, a hormone associated with physical and psychosocial stress, has been examined both in modern as well as ancient human hair. In archaeological scenarios where lengths of hair are preserved, osteoarchaeologists are able to assess stress prior to an individual’s death. This can provide important information about the lived experience of the individual in the weeks and months prior to death. Here, cortisol is assessed alongside skeletal indicators of non-specific stress, specifically cribra orbitalia, porotic hyperostosis, and bilateral periostitis. It is hypothesized that persistently elevated cortisol might weaken the immune response, thereby increasing the likelihood of non-specific stress indicators.

Hormone and skeletal analysis were conducted on ancient Nubian skeletal remains from the archaeological sites Abu Fatima (2500-1550 BCE) and Tombos (1550-656 BCE). These two contexts differ in socioeconomic standing, which may provide variation in cortisol levels. Preliminary analysis indicates that levels of cortisol prior to death are quite variable. There does not appear to be any connection between elevated rates of cortisol and the presence of non-specific stress indicators; however, sample size was small, owing to a limited number of archaeological hair specimens. When the osteological paradox is taken into account, another possible explanation is that some individuals may have died before non-specific stress lesions developed (i.e., frailty). Future research, incorporating a larger sample size in addition to forensic testing, is necessary.
The repatriation of Ainu human remains: the role of archaeologists and anthropologists.

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After the decades of the debate, the importance of the repatriation of Indigenous human remains has been largely recognised by archaeologists and anthropologists and many of them have played significant active roles in repatriation by providing professional skills in global contexts. Such movement has promoted dialogues between descendant communities and researchers, and hence contributed to the development of a more inclusive model of Indigenous archaeological projects. In Japan, Indigenous archaeology is still underdeveloped and the repatriation of Ainu ancestral remains is controversial. This paper addresses the issues concerning the current repatriation and legislation of Ainu human remains by analysing recent attempts of communication concerning research between Ainu activists and researchers. Despite the establishment of codes of ethics between some Ainu group and associations of archaeologists and anthropologists, the lack of awareness among Japanese researchers including osteologists and geneticists causes the miscommunication with descendants. The colonial Ainu archaeology and anthropology which were rooted in social Darwinism are yet to be critically examined. The lack of consideration of the impact of their research to various stakeholders including Ainu communities is also recognised. As a consequence, recent repatriation and reburials have taken place as the results of activists’ lawsuits against universities that hold ancestral remains rather than the act of decolonisation of archaeology/anthropology or developing better relationships. Regarding these, actively contributing to the repatriation and establishing the dialogue between Ainu communities by sincere communication must be the urgent challenges need to be addressed by archaeologists and anthropologists.
When biomechanics isn’t everything: towards comprehensive palaeopathological approaches to identifying neurodegenerative disorders.

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Tracing rare neurodegenerative disorders in the human skeleton is customarily considered an onerous, if not impossible task due to the difficulties of establishing descriptors for skeletal changes associated with chronic forms of diseases involving severe muscle degeneration such as MND and the complex differential diagnosis on clinical and osteological level. However, a consideration of the prevalence of such disorders today and a new appreciation for the bioarchaeological investigation of rare diseases reveals the invisibility of individuals suffering from such conditions in the past. Given the enormous physical, psychological and social effects and emotional toll of such diseases, it is paramount to sustain the effort to identify these in the bioarchaeological record.

This paper presents a critical appraisal of the available evidence for palaeopathological analysis of neurodegenerative disorders through synthesis of clinical and skeletal data. First results of mapping skeletal manifestations of MND and reviewing potential causations for entheseal changes suggest a distinct role of oxidative stress in the formation of skeletal markers as an effect of allostatic disturbances. It is hypothesised that our interpretation of entheseal changes, routinely associated with biomechanical stressors, benefits from including biochemical and neurological factors in the bone-muscle crosstalk, ultimately providing a better comprehension of disease mechanisms, new avenues for understanding the bone-muscle interface, and facilitating the analysis of neurodegenerative disorders from the skeleton. This paves the way towards a multidimensional palaeopathological appraisal of these types of rare diseases and a holistic understanding of disease and disease experience in the framework of the bioarchaeology of care.
Femoral cross-sectional geometry and locomotor development in children from post-medieval London.

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Archaeological assemblages provide a unique opportunity to explore the ontogenetic changes in bone strength in past populations, as the amount and distribution of cortical bone in long bones is indicative of structural resistance to mechanical loading. Children subject their femurs to various loading environments as they transition from a relatively immobile state at birth to mature bipedal walking at around 4 years old. Here we explore biomechanical changes incurred during locomotor development in infancy and early childhood by examining cross-sectional geometry (CSG) at three different locations of the femur.

Micro-CT scans were generated from 112 subadult femora from 18th and 19th century London with documented age at death ranging from birth to 8.5 years old. Following virtual alignment of CT stacks, CSG properties including cortical and medullary area, second moments of area and orientation of maximum bending, were analysed from 2D slices extracted at 35%, 50% and 65% of total intermetaphyseal length.

Clear changes were observed between successive stages of locomotor development. Initially, there is a sharp decline in the ratio of cortical to medullary area from birth to mid-infancy, which was most evident at the 35% cross-section. This redistribution of cortical bone away from the centroid coincides with the onset of weight-bearing activities such as crawling and may be mechanically advantageous at this stage. The highest level of mediolateral reinforcement coincides with the onset of toddling and may reflect the distinctive load patterns associated with immature gait. This study demonstrates the relationship between bone remodelling, growth and locomotor development.
Reconstructing the lumbar spine morphology of extinct hominins: a quantitative 3D approach.

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The lumbar lordosis is a sagittal curvature involved in the evolution of locomotion. However, its reconstruction in hominins is difficult because of the bad preservation of key anatomical structures in the fossil record. Here we assessed the morphological covariation between individual lumbar vertebrae and the entire lumbar spine to reconstruct the lumbar spine of the Early Pleistocene juvenile H. ergaster KNM-WT 15000 and of the Late Pleistocene Neanderthal adults Kebara 2, Shanidar 3 and La Chapelle-aux-Saints 1. We segmented Computed Tomography data of N=44 adults and N=32 juveniles (7-12 years old) and we measured 730 (semi-)landmarks on the resulting 3D virtual models. We used the Partial Least Squares (PLS) method to calculate covariation models within adults and juveniles (for the Neanderthals and KNM-WT 15000 predictions respectively). The PLS predictions were performed from the isolated vertebrae that yielded the highest percentage of covariation with the whole lumbar spine. We finally measured the LA of the lumbar spine predictions. Neanderthal fossils fell within the adult human variability but below the human mean (LA human range: 30-79°, mean 51.5°±11). Kebara 2 and Shanidar 3 showed the least lordotic lumbar spine predictions (LA~42°) and La Chapelle-aux-Saints 1 had the most lordotic lumbar spine prediction (LA~48°) among Neanderthals. KNM-WT 15000 falls within the human range variability but shows a lordotic angle (LA~52-54°) above the juvenile human mean (LA 8-10 years old= 37°±7, LA 11-13 years old= 39°±9). Our results reveal the potential of this 3D quantitative method to reconstruct the lumbar lordosis in extinct hominins.
Multiple perimortem sharp force trauma in an individual from the early medieval cemetery of Säben-Sabiona in South Tyrol, Italy.

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Trauma analysis provides important information on the scale of violence, hazards associated with daily activities, the reoccurrence of conflicts as well as whether injuries lead to death. In contrast to modern cases, bioarchaeological samples are often less extensively studied.

This research provides the first detailed analysis on fatal interpersonal conflict in the Early Medieval Italian Alps.

Individual SK63 was buried within the early Christian church (5th-8th centuries AD) of Säben-Sabiona in South Tyrol (Italy) in Christian funerary tradition.

The skeleton underwent a detailed macroscopic, microscopic and metric analysis, whereby signs of trauma detected on the cranial and postcranial skeleton were in particular focus.

SK63 was a 19-25 year old male. Trauma analysis identified at least 29 lesions, consisting of three possible antemortem injuries and 26 perimortem sharp force trauma on the cranium (n=4) and postcranium (n=22). More than half of the injuries were located on the left side (69%, 19/26), whereby the ribs and spine were most often affected (50%, 9/18), followed by the bones of the upper limbs and shoulder girdle (28%, 5/18). In contrast to this, 80% (4/5) of the cut marks on the skull were located on the right side.

The trauma pattern observed indicates that interpersonal violence rather than a large-scale conflict led to the death of SK63. Further, the injury typology and appearance indicate the use of different bladed weapons to inflict trauma.

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This research investigates vitamin D deficiency patterns in individuals from birth to the beginning of adolescence. Microscopic computed tomography (micro-CT) assessment of interglobular dentine (IGD) in teeth provides information on the age of disease onset and the number of deficient periods per individual, which will increase our understanding of factors influencing vitamin D deficiency prevalence, including sociocultural practices and latitude.

Two Dutch 17th-19th century communities, Beemster and Hattem, yielded relatively high prevalences of rickets (15–24%) and residual rickets (15–24%). From the affected individuals, a subsample of 30 teeth were selected for micro-CT scanning. Thin sections were made of 17 teeth, consisting of 6 teeth with and 11 teeth without observable IGD on micro-CT that were included for method comparison. Nineteen out of 29 (65.5%) individuals (one tooth was deemed unobservable) presented with IGD on micro-CT. Eight of the 11 (72.7%) individuals without IGD on micro-CT demonstrated histologically visible IGD. In 40.7% (11/27) of the affected individuals (combined micro-CT and histology results), vitamin D deficiency was recurrent, and in four individuals, some episodes occurred at approximately annual intervals suggesting vitamin D deficiency was seasonal. In three individuals, IGD occurred in the dentine formed around birth, suggesting maternal vitamin D deficiency. Micro-CT assessment of IGD is found to be a valuable non-destructive method that can improve our understanding of the influence of sociocultural practices and latitude on disease development within age and sex groups in past communities.
Investigating dental wear from the Neolithic to medieval, in the Middle Nile Valley, Sudan.

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Rescue archaeology from the Fourth Cataract region of the Middle Nile Valley has recovered skeletal assemblages ranging from Kerma to Medieval times. These remains, from a geographically focused area, allows in depth examination of dental wear from a region about which little is known. This study contrasts data from these sites with others from the Middle Nile Valley, concentrating on the pattern and angle of dental occlusal wear and non-masticatory wear related to behavioural practices. 589 individuals were examined, using visual and digital recording of the occlusal surface. Results suggest clear differences in the pattern and angle of wear between periods, in particular the Kerma period shows relatively equal use of all the dentition and flatter angles of wear, while other periods show preferential use of the anterior teeth with angled oblique wear even at low wear stages. These results may indicate that the diet in the Kerma period consisted of tougher, harder foods, leading to more lateral deviation of the jaw during mastication and a more even and flatter pattern of wear than groups which may have had softer more processed foods. With increasing aridity and changing agricultural practices throughout these periods, the differing ways in which individuals were using their mouths may reflect dietary and food preparation transitions. These data give us a unique insight into the inhabitants of the Middle Nile Valley over a wide period, increasing understanding of behavioural practices and biological processes inherent in these groups.
What does it mean? Investigating the cribrous syndrome in children and young adults in Britain.

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While many study cribra orbitalia to assess health in past populations, the introduction of cribra humeralis and cribra femoralis has sparked aetiological debates regarding cranial and postcranial cribrous lesions. Current theories suggest that these three cribrous lesions are in fact one single condition, the ‘cribrous syndrome’, and are the result of marrow hyperplasia. Some believe that this is more specifically an indicator of anaemia, yet several other aetiological theories have been suggested without any definitive conclusion. Additional problems stem from recording cribra humeralis and femoralis: this has been limited in the published literature to assessing lesion prevalence in a given population, without any further understanding of its aetiology.

Through the application of a new scoring scheme devised by the author, this study examines individuals between foetal and 35 years of age from four sites in Britain to provide more detailed analysis of the cribrous syndrome. Numerical scores from the scoring scheme were assigned to each sector of an affected lesion area, with a summation of these scores for each skeletal element and an overall cribra score for the individual compared amongst age categories in each population. This analysis of 300 skeletons showcases interesting trends of cribrous scores with age, with further comparison between populations providing insight into any possible environmental or dietary impacts on the cribrous syndrome. The results demonstrate that this new form of analysis not only offers more detailed information on cribrous lesions than assessing prevalence alone, but also could help clarify the aetiology of the cribrous syndrome.
Abscesses and other periapical lesions in human dentition, from the medieval site of St James Abbey, Northampton.

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Periapical lesions and voids in the human jaws have been reported as abscesses in the literature, which implies pain and infection. However, histological and odontological studies indicate that such lesions and voids are relatively common in past populations and are usually painless granulomata or cysts. Less than a third may be indeed infected. In archaeology and osteoarchaeology this matter has not attracted the attention it deserves. The aim of this study is to create a methodology which can be used to discriminate between periapical lesions of jaw bones and to examine the deformities of the alveolar process. This methodology has been applied to 45 individuals from the medieval monastic site of St' James and the results could also inform on the oral health and diet of the site. Through the creation of a recording sheet in which the dental pathology and the alveolar deformities have been recorded separately, the results show in many cases that the periapical lesions were not abscesses, but granulomata or cysts instead. This case of study demonstrate the importance of identifying and classifying the differences between periapical lesions for the interpretation of oral health and diet, providing a useful approach that be applied in different populations and chronological periods.
The influence of footwear on hallux valgus prevalence in Anglo-Saxon and Victorian Britain.

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_Hallux valgus_ (HV) is the lateral deviation of the first toe. This forefoot deformity has been associated with the wearing of high heeled shoes in modern populations. Few studies have investigated the association between footwear and the prevalence of HV in historical populations. Two large skeletal assemblages from the North East of England were examined to investigate the prevalence of HV. The feet of 84 individuals from the Anglo-Saxon population of Black Gate cemetery, Newcastle-upon-Tyne, and 61 individuals from the Victorian population of Coronation Street, South Shields were examined. HV was diagnosed by the measurement of articular angles of the great toe using methods recommended in current clinical guidelines. The true prevalence of HV in the Black Gate cemetery population was 29.3%, and 86% in the Coronation Street cemetery population. The prevalence of HV was significantly higher in the Coronation Street population when compared to the Black Gate skeletal assemblage (Chi² = 51.52, P-value = <0.001). No statistically significant difference was found between HV and the estimated age at death or biological sex within both study populations. The higher prevalence of HV observed in the 18th – 19th century population of Coronation Street is consistent with the increased use and accessibility of narrow toed, high-heeled shoes worn by men and women in the Victorian era.
A question of calibration: comparing inverse and classical calibration on a recently developed age-at-death estimation method.

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Linear regression is widely popular in osteoarchaeology, especially for development of age-at-death estimation methods. The most common application is inverse calibration (independent variable regressed on dependent variable), which is a biased estimator at risk of mimicking the reference population. Conversely, classical calibration (dependent variable regressed on independent variable) is considered unbiased. In this study we will use a nonadult age-at-death estimation method based on dental wear to compare the application of classical and inverse calibration. The method was applied to pseudo-random samples (n = 100 per sample) with normal, negatively skewed, and uniform age-at-death distributions, developed with a similar wear rate as the reference population. Since the method was developed using inverse calibration, this study examines the method for potential bias. The accuracy was calculated based on estimates within 2 years of the actual age. Each distribution was tested using a Monte Carlo simulation with 1,000 iterations. The method was consistently more accurate for inverse calibration for the normal (70%; 72%), and uniform (69%; 70%) distributions, but not the skewed (67%; 66%) distribution. Compared to the actual distribution of the normal (mean = 10.1 years), skewed (mean = 13.5 years), and uniform (mean = 10.6 years) samples, the estimated distributions for both inverse (means = 9.1; 12.2; 9.5 years) and classical (means = 9.2; 12.5; 9.6 years) calibration were minimally affected by the reference population (mean = 8.0 years). These results suggest that the method can be reliably applied to populations with similar rates of wear.
Destructive sampling of human tissues: guidelines for best practice in collections-based research

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Destructive sampling of human remains from museum, commercial, and university collections for biomolecular analyses has proven to be a crucial process for researchers to better understand the evolution of pathogens, diet, and migration. As the demand grows for samples, many institutions face tremendous pressure to not only facilitate research but also maintain the integrity of these collections. One example of this is the 650% increase in applications for access, with 40% of those for destructive analysis, to the Duckworth Laboratory at the University of Cambridge between September 2017 and September 2018. In light of this, members of the Duckworth Management Committee consulted to other professionals facing similar issues and created a workshop at the British Academy in London to discuss ways to deal with sampling protocol, ethics, and accessibility while also addressing discrepancies in sampling between commercial and institutional collections. As analytical methods improve there is increasingly more that can be done with less sample. Other issues discussed are multiple versus single tissue sampling and the creation of biobanks to hold sample residues for access. This poster presents the results from this workshop in hopes to create a best practice document to supplement the BABAO Code of Practice and Code of Ethics.
Hyperostosis frontalis interna (HFI) is a common and well-recognised osteological condition in which raised, lobulated outgrowths of bone are present on the endocranial surface of the frontal bone. Although the aetiology of the condition is unclear, its strong association with older, post-menopausal females suggests a hormonal cause— in particular, exposure to the sex hormone oestrogen. HFI is very much rarer in males than females (a ratio of 1:12 in historical skeletal assemblages), and where it does occur, is found predominantly in older males. In modern males, HFI has been associated with testicular atrophy, and with androgen suppression treatment for prostate cancer. It was also recognised in the skeletons of two prepubescent castrates— one being the famous 18th century castrati, Farrinelli.

The presence of four cases of HFI in an assemblage of 450 skeletons of British Royal Navy seamen and marines from the first burial ground of the Royal Hospital Plymouth, Plymouth, Devon, England (1756-1824), is thus noteworthy, particularly as this assemblage overwhelmingly comprised younger servicemen who died on active service (most aged less than 35 years). Explanations for the unusual presence of HFI in this group are multiple and possibly fanciful, but reflect the eclectic, international nature of the seafaring community, the physical dangers of sailing a fighting ship, and geopolitical factors of the day. Testicular trauma incurred whilst sailing a ship may account for some of the cases of HFI (contused testicles and groins being a not uncommon cause of admission recorded in the muster books of Plymouth Hospital). One mature adult male with HFI showed craniomorphology strongly suggestive of Far Eastern ancestry, raising the possibility that a eunuch from Imperial China had found his way into the RN. Less probable, yet historically attested is the capture and enslavement of R.N. seamen by Barbary pirates and the Ottoman Empire, both of whom are known to have practiced castration of their male slaves.
Hyperostosis frontalis interna in the British Royal Navy (1750-1815).

Boston, C.¹

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In palaeopathological studies, consideration of the functional or social impact of pathological alterations is uncommon, and the life experiences of individuals with physical impairment are therefore overlooked. This project aims to investigate the implications of physical impairment in Anglo-Saxon England through a combination of palaeopathological, funerary, and historical analyses.

The funerary treatment information (body/limb positioning, burial location, grave good inclusion, etc.) of all individuals from 19 Anglo-Saxon cemeteries was gathered. Individuals previously identified as possibly physically impaired (severe infection, alterations resulting in abnormal locomotion, clear observable deformity, etc.) were re-analysed by the author. The burial treatment of the individuals with physical impairment was compared to that of the rest of the population.

Preliminary results demonstrate that there was no standard mortuary treatment for the individuals with physical impairment. In general, their mortuary treatment was just as variable as that of the remaining population, and there appears to be no effort to differentiate the physically impaired from the rest of the population.

However, there are exceptions to this trend with various examples of individuals with physical impairments afforded mortuary treatment with both positive and negative connotations (Edix Hill 42B: adult female with leprosy buried on a wooden funerary bed; St. Anne’s Hill 481: adult male with leprosy buried in complete isolation).

These data suggest that burial treatment of and attitudes towards individuals with physical impairments varied between populations throughout the Anglo-Saxon period, emphasising that various, complex influences on human attitudes must be appreciated in archaeological disability studies.
Digital recording techniques for osteological material: a comparison between standard high-resolution photography, “light revolution” system, and photogrammetry.

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Digital recording of bioarchaeological material facilitates repatriation efforts, preserves data from post-depositional processes, and allows a wider audience to access the material. However, the recording technique selected can greatly affect the final output. In this investigation, a proximal humerus and scapula showing evidence of pathology were recorded with high-resolution photography, photogrammetry, and a new multi-platform lighting and camera system called Light Revolution (light-revolution.com). Accuracy for displaying surface texture and detail, fundamental for the correct evaluation of osteological remains, was considered along with budget, training, and time required.

High-resolution photography was the least expensive technique. However, the two-dimensional nature of photography creates limitations for researchers focusing on different aspects of the bone. The advantage of Light Revolution was that the system of multiple variable lights created an extreme range of high and low contrast image options. The images reveal details invisible to the naked eye. As the process is partially automated, image capture took the least amount of time. However, it was the most expensive technique. Photogrammetry costs slightly more than high-resolution photography, yet it provides a three-dimensional model and high-resolution images. The process is time-consuming and requires additional training, but the model allows researchers to virtually handle the material and make new interpretations.

These techniques do not replace direct observation, but they can provide complementary perspectives and be used in cases where remains are no longer available. This comparison demonstrates that each technique provides new insights and should be chosen based on the research question, resources, material, and desired outcome.
Life and death in late antiquity Calabria (Italy): the case of the 4th-6th century community from Scolacium.

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The archaeological site of Scolacium (Calabria, Italy), situated on the narrowest isthmus of the peninsula, at the centre of the Mediterranean Sea, has been one of the most important trading point and crossroads of people and cultural exchange until the beginning of the Middle Ages. After a long period of prosperity as a Greek sub-colony (Skylleton, 6th-4th centuries B.C.) and a great Roman town (Scolacium, 1st century B.C. – 4th century A.D.), the site was affected by a socio-economic and cultural transformation due to a succession of new and different dominations (Goths, Byzantins) and religions, during the Late Antiquity period. Despite the numerous historical and archaeological sources about this period of Scolacium, the local population dynamics remains unknown. What were the life conditions and the cultural practices during this era of profound transitions?

The aim of the present study is to provide a preliminary insight into the lifestyle, health, and funerary customs in Late Antiquity Scolacium. We performed a macroscopic bio-anthropological analysis on the skeletal collection from the 4th-6th century necropolis excavated inside the archaeological site. In addition, a reconstruction of depositional practices of the deceased through the examination of the photographic records of the burials taken during the fieldwork is included.

The combination of the bio-anthropological and funerary archaeological approach allows new knowledge about the potential effects of the socio-economic and cultural changes on the population of Scolacium and new information on the transition between the fall of the Western Roman Empire and the beginning of the Middle Age.
Two cases of Paget’s disease of bone from Poulton Chapel, Cheshire, UK.

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2. Chapel Archaeology, UK.
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Paget’s Disease of Bone (PDB) is a chronic, metabolic disease disrupting normal bone turnover. This disease is characterised by excessive bone remodelling resulting in bone enlargement, fragility, deformity and additional complications. Typically, PDB affects one or a few bones of the axial skeleton and is commonly recorded in older individuals (over 55 years of age) affecting more males than females. Although PDB has been reported worldwide, there is a high concentration of reported cases in the UK, with a regional hotspot in the northwest of England. This study reviews an adult male (SK463) and female (SK750) with skeletal lesions of PDB from Poulton Chapel, Cheshire. Full macroscopic and radiographic analysis has identified the skeletal distribution of PDB, with up to 75% of both skeletons affected. SK463 presents noticeable anterior bowing to both tibiae, likely the result of PDB. AMS radiocarbon dating and stable isotope analysis performed on teeth samples confirmed that both individuals dates were medieval, had a mixed/varied diet and were local to the northwest of England. This research adds to the emerging paleopathological literature on PDB, while providing additional support for the identification of a geographical hotspot observed in contemporary populations.
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Excavations at the medieval cemetery of Poulton Chapel have uncovered over 900 articulated human skeletal remains, with numbers increasing as excavations continue. In 2011, an interesting discovery surrounding the burial of SK535, provided a glimpse into a traumatic aspect of medieval life. Osteological analysis has identified SK535 as a middle-adult male around 168cm in stature. His burial position was typical of Christian burials (east-west orientation) however, the positioning of his arms was not so typical. His right arm was flexed at the elbow crossing the thorax while the left arm was in the extended position. This is different from the other arm positions observed at Poulton Chapel. Additionally, a Type M7 bodkin arrowhead was recovered from underneath the right arm, from within the thorax. This arrowhead was potentially amour piercing and was commonly used during the 12th-13th Centuries. Radiocarbon dates obtained for SK535 coincide with the time of use of this arrowhead. Only one other instance of trauma was identified in SK535, a healed Parry fracture to the right distal ulna. Due to the location of Poulton Chapel, SK535 could have been wounded by an arrow carrying the M7 bodkin during English-Welsh border skirmishes which occurred frequently during this time period. The demographic profile of this individual indicates a possible professional fighter of the medieval period. However, no other firm evidence of occupation could be provided. Nonetheless, this case study highlights the violence experienced during the medieval period, but also indicates the ability for the survival of some traumas.
3D Slicer as a tool for creating virtual bone models: towards validating guidelines for modelling CT data.

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Computed tomography (CT) scanning can be used for generating 3D models of skeletal elements from both decedents and living patients. However, in practice, CT accessibility can be limited by factors such as the high cost of software, a lack of user-knowledge and a lack of tested best-practice guidelines. This study aimed to address two questions: 1) is it possible to create guidelines that can be used by a 3D modelling novice? 2) is it possible to validate these guidelines by showing that the models produced are robust?

Guidelines were developed using 3D Slicer, a free open-source platform and tested by five observers, who followed the guidelines to produce twenty 3D models using clinical sinus CT scans (n=20). The models were evaluated via a qualitative assessment, and a comparison of sex-determination scores. Additional observers took part in a validation test and statistical analysis assessed the degree of observer agreement.

All observers successfully produced twenty 3D models that were consistently of good quality with no major differences in skull morphology. A high degree of observer agreement was found in the sex assessment scores and the validation test. This study found that 1) novice users could create 3D models following the guidelines, and 2) robust 3D models of human crania were created, which validated the utility of the guidelines. This research presents empirically tested guidelines for modelling 3D skeletal elements from CT data that ultimately provides a standardised and accurate visualisation method that can be used reliably in future research.
Deadly lead? Preliminary report on the study of lead production, lead exposure, and health on an imperial Roman estate in Italy.

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The *Deadly Lead* project investigates the entire picture of lead production and consumption at the Roman rural estate at Vagnari in south-east Italy, ranging from the physical context of manufacturing in the estate village, and the procurement and processing of ores, to the physiological effects of this type of industrial production on the men, women, and children living and dying here. We have the distinct advantage at Vagnari of knowing exactly where the people lived and worked with this toxic material, and we have their physical remains in the village cemetery.

Preliminary results of the analysis of the lead manufacturing debris and artefacts recovered in the village suggest that the ores were extracted from mines in Sardinia and/or western Italy, a source confirmed by the study of the lead in the teeth of skeletons in the cemetery. In addition, laser ablation of the first sample of nine permanent 1\textsuperscript{st} molars from Vagnari reveals that two individuals (one adult female, one subadult) had highly elevated lead levels (up to 37.7 and 16.5 ppm respectively), while the other individuals had levels that range from acceptable to moderately elevated (range - 0.2 to 7.8 ppm). This research will give us important insight into lead production and the risk of lead exposure among rural Roman communities.
Investigating the prevalence of concha bullosa in medieval populations.

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An increasing awareness of the evidence for respiratory disease in osteological collections has developed over recent decades, including concha bullosa, or pneumatization of the nasal turbinates and/or nasal conchae. Intriguingly, while concha bullosa is rare archaeologically, it is the most common anatomical variant of the osteomeatal complex in current populations. The broader aims of this research are to apply existing diagnostic tools, and ideally develop new ones, in the identification of respiratory disease (including concha bullosa) in Medieval Scottish assemblages, with the immediate aim of this paper being to explore this condition in two smaller samples. Materials include skeletal series from Medieval Whitefriars (Perth) and the Green (a Carmelite Friary in Aberdeen). Each individual with preserved nasal and sinus structures was assessed for respiratory disease using published criteria (including gross examination and imaging). Preliminary results suggest several individuals meet one or more diagnostic criteria for concha bullosa. Discussion focuses on contextualizing this condition with respect to age, sex, and other skeletal signatures of well-being in these samples. Finally, while not necessarily life threatening, concha bullosa and other upper respiratory conditions deserve more attention in osteoarchaeology and paleopathology due to their potential for exploring the impact this condition may have had on those afflicted with concha bullosa.
A bioarchaeological study of chronic maxillary sinusitis and respiratory health in two post-medieval populations from the Netherlands.

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The occurrence of chronic maxillary sinusitis has long been associated with poor living conditions and one hypothesis suggests that densely populated environments and poor air quality exhibit a higher incidence of sinusitis. In this study, the occurrence of sinusitis is reported and compared in two post-medieval skeletal collections from the Netherlands: the rural population of Middenbeemster (n=54) and the urban population of Arnhem (n=51). With the use of an endoscope, both left and right maxillary sinuses were examined for all individuals.

Overall, 50 individuals (47.6%) showed signs of sinusitis in one or both maxillary sinuses with a higher prevalence found in the Arnhem sample (56.9%) in comparison to the Middenbeemster sample (38.9%). Exploration of the effects of sex and age-at-death was investigated for both samples. However, no significant differences were observed. The results suggest that individuals could be at higher risk of sinusitis in an urban environment in comparison to their rural counterparts. Interestingly, the lack of differences between the sexes or age groups suggests that social and occupation environments do not differ enough within these two samples, which is contradictory to historical sources where males and females have their own specific roles within a community exposing them to different risks (e.g. Middenbeemster historical records show how men were involved with outdoor agricultural activities, while women usually took care of the house and likely spent the most of their time indoors). Further research is being considered to explore maxillary sinusitis as a tool to assess air quality in past populations.
Recognizing interpersonal violence: a case study in medieval Aberdeen.

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Between 1980 and 1994, excavations of the Green in Aberdeen, Scotland, uncovered 201 burials and revealed the remains of a Carmelite friary. Founded in 1273, the friary contributed significantly to city life in Medieval Aberdeen until its destruction during the Scottish Reformation. Life at the friary and its context has been discussed in the recently published excavation report by Alison Cameron, Judith Stones, and Chris Croly, which also includes the general skeleton report that was conducted 25 years ago. Through gross examination, several individuals have presented with severe markers of stress and fractures, including penetrating and radiating fractures. This new project investigates the bioarchaeology of care and skeletal trauma patterns of potential victims of interpersonal violence. The most prominent case being SK 239, a skeleton with a healed fractured rib, spondylolysis, bowing of the left metatarsals, an extensive blade wound on the occipital bone and a small cut mark on the right humerus, confirmed to be from the same weapon. The occipital wound shows surface scratches which suggest an attempt to treat the individual by removing fragments of bone. In conclusion, this research provides a new osteological outlook on physical trauma in the Green, thereby shedding light on the implications of interpersonal violence on individuals in the context of Medieval Aberdeen.
The relationship between growth parameters and nutritional patterns in immature individuals: a preliminary study of Black Gate cemetery, Newcastle (7th-12th century AD).

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Early life experiences are known to influence health and growth in later life. Proper breastfeeding and weaning processes are fundamental for the optimal development of children, as breastmilk provides the infant with all the nutrients required for their growth, while at the same time bringing immunity factors which protect infants against illness. Moreover, periods of ill health in early life can also impact physical development and health outcomes into adulthood.

This study analysed different growth parameters including linear growth, appositional growth and evidence of linear enamel hypoplasia, in order to characterise the growth patterns of a sample of 55 immature individuals from the Black Gate skeletal collection (7th-12th century AD, Newcastle, UK). Relationships between these growth parameters and the nutritional status of this population were explored using data obtained from incremental and bulk sampling of dentine and bone collagen for nitrogen and carbon stable isotopes. The results indicate that in most cases when suboptimal breastfeeding and weaning or physiological disruption was indicated, individuals tended to be short for their age. The sample size was small, and so limits the interpretations we can draw from this study. Nonetheless, our findings demonstrate both the necessity of analysing a varied range of growth parameters to study immature growth and evidence how stable isotope data can provide complementary insight into previously inaccessible aspects of infant nutrition.
Micro sampling of dentine and bone collagen for stable isotope analysis.

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Carbon and nitrogen stable isotope analysis of dentine and bone collagen is used to study an individual’s diet, nutrition, and mobility. Previous research has shown that high-resolution temporal sampling of dentine has shown the capability of providing information about diet and mobility during the formation of the collagen; however, temporal sampling of bone collagen is limited.

This pilot study was conducted to determine if micro sampling of dentine and bone collagen could be used to increase the temporal resolution of carbon and nitrogen isotope analysis. The method was applied to modern samples. The authorities at the University Hospital, Khartoum approved the teeth samples provided by individuals who signed consent forms to approve the use of their tissue for research and the project and the bone samples were faunal samples collected from a butcher’s shop.

The collagen was sampled from demineralized bone and dentine collagen using a New Wave Micro Mill. The micro mill is used to drill consecutive trenches in the dentine collagen following the growth pattern of the tooth. The data show carbon and nitrogen isotope ratio values averaged every 3-4 months of tooth formation. Using the micro mill, osteon were sampled from the bone collagen to provide a temporal resolution.

The results show that both the dentine and bone collagen methods of sampling will increase the temporal resolution provided by incremental sampling.
Keeping it real: testing the validity of three-dimensional (MVS-SfM) constructs for recording and interpretation of mass burials.

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This research focuses on mass graves and the permanent record of the excavation in three-dimensions (3D). It explores whether 3D point clouds, generated through multi-view-stereo structure-from-motion (MVS-SfM) photogrammetry, are applicable for recording complex deposits of human remains.

The material for this study comprises casts of human remains, which have been deposited in a simulated mass grave. Two photographic datasets of the assemblage were produced. The first set was taken when digging, depositing the casts and re-filling, while the second was captured during excavation and lifting of the bones. The photographs were acquired with a camera and a monopod and then used to generate 3D point clouds. In order to acquire metric data, to compare and merge multiple layers, measurements were taken using coded targets and a robotic total station theodolite (TST).

The preliminary results allow a comparison between the two sets of 3D point clouds. Among the factors evaluated during the comparison are the effects of the re-filling and the excavation process on the position of the remains. 3D point clouds are a powerful medium to represent spatial relationships of buried human remains. With the technology to create 3D models becoming increasingly accessible, there is a need to test the validity and reliability of such models, especially if presented as evidence for medico-legal proceedings. Moreover, such digital recording permanently stores the excavation sequence and relationships in a form inaccessible using conventional recording techniques.
The anthropological and osteological significance of trepanations: contextualising two case studies from Soham Cambridgeshire.

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Trepanning is one of the first surgical practices to be developed by humans. It involves the drilling and/or cutting of a large hole in the cranium of a live individual to cure ailments such as epilepsy and chronic headaches. It is also theorised to have been practiced ritualistically on the living and the deceased. The aim of this research is to find a context within which to place the trepanning of two Anglo Saxon skeletons. The skeletons were recovered by Archaeology South East (UCL) in Soham, Cambridgeshire. Two adult male skeletons [SK2249, SK2097] were recovered from the site and were determined to have had examples of trepanned crania, that both showed significant signs of healing.

The trepanations will be analysed with the naked eye, macroscopically, utilising a 3D model complied from images taken of the skull, alongside photographs. Both crania have defined examples of trepanned holes in their cranial bones, with one having probable pathologies to explain why the trepanations took place. The Saxon period is not one in which trepanning was common place. The operation was conducted sparsely, perhaps by a single individual as theorised by Calvin Wells. While unlikely, many of the trepanations appear to be relatively uniform in how they were conducted and in spite of a lack of reference to trepanation in historical texts from the time period. This would suggest knowledge for conducting the operation successfully was readily available.
A case of achondroplasia in a young juvenile from medieval southern England.

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Amongst the bones of over 100 earlier medieval townsfolk from a riverside cemetery on the south coast of England were those of a five-year-old child, whose unusual skeletal morphology points to achondroplasia, a genetic disorder affecting cartilage that causes the most common form of disproportionate dwarfism. At present, there are no indications that this child had received any special or disparate treatment in death. Historical research will help us to gain insight into how they may have been perceived and treated in life.

Despite the condition being well-documented historically, osteoarchaeological examples of dwarfism are not common. Of the seven reported cases from British assemblages, four have been attributed to achondroplasia – a tentative Neolithic case, a 7th–9th-century infant from Pembrokeshire, an adult from medieval London and another from Newcastle (19th century). Examples of the mesomelic and pituitary forms of the condition comprise an adult from Romano-British Dorchester and Gloucester, and early medieval Tyne and Wear.

The current discovery provides the opportunity to study the young skeletal manifestations of the condition – including a characteristic that is only recently the subject of specific clinical scrutiny – and share the findings with other researchers, including via digital and printed 3D modelling.

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Since the medieval period, anatomical dissection has been considered the cornerstone of medical education. In recent decades, a number of archaeological excavations have uncovered evidence of this practice in the form of tool marks on human skeletal remains. At the majority of sites where dissected individuals were uncovered, considerably more men were found that women. The aim of this research is to investigate how the postmortem treatment of medicalized bodies differed according to gender during the nineteenth century. To do this, the skeletal remains of dissected adult male (n = 74) and female (n = 25) individuals from the Royal London Hospital and the University of Cambridge were analysed. The location and orientation of the tool marks were recorded, and silicone casts (n = 43) of tool marks were analysed using scanning electron microscopy. The assessment of the tool marks revealed no differences in how the bodies of men and women were dissected, nor were there any differences in the tools used. This suggests that the sociopolitical status of women, which necessitated their protected treatment during life, shifted drastically after death. Rather than a preference to dissect male bodies, the gender disparity in the archaeological record can be explained by the social roles of women, which made it less likely that they would die in hospitals or remain unclaimed from workhouses. However, the bodies of women that were dissected were not viewed as fragile or afforded protected status by anatomists, as they were dissected in the same manner as men.
Lifeways at Llangefni: recent investigations of an early medieval cemetery on Anglesey.

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The site of Llangefni College Campus, located on Anglesey, northwest Wales, revealed an early medieval (4th-8th Centuries AD) cemetery containing 31 individuals. Unusually for Wales, remains were relatively well-preserved, allowing for standard osteological recording and multi-isotope ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$, $\delta^{18}O$, $^{87}Sr/^{86}Sr$) analysis for investigations of lifeways, diet, and geographical origins. Preliminary results indicate that this sample is largely adult, generally healthy, and highly mobile, challenging earlier assumptions of an agricultural community. Two phases were identified, with earth-cut graves dominating the first phase and cist graves as the norm in second phase. $\delta^{34}S$ values are consistent with an environment near (<50km) the coast; however, $\delta^{18}O$ values range widely, with most individuals inconsistent with Anglesey and four individuals suggestive of non-British origin. Previous work by Hemer et al. (2013) found evidence for migrants from across Britain and the Mediterranean in south Wales. This project is consistent with Hemer’s results, with most migrants consistent with regions around modern Welsh-English borders and south England, but also found evidence for migrants from cooler regions, such as continental Europe or Scandinavia. This range in oxygen values, combined with the change in burial rite from earth-cut grave to cists, may indicate the presence of an economically active trading or religious centre at Anglesey. Interpretations must be caveated by preservation bias and poor isotope mapping in this region; however, despite interpretive limits, this study represents the second-largest isotope study on medieval Welsh remains. The evidence from Llangefni further illuminates our understanding of Wales in the so-called ‘Dark Ages.’
Sex and the cities: urbanization’s influence on sexual dimorphism in the post-medieval Dutch.

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Sexual dimorphism of the human skeleton primarily presents through the morphology of the skull and pelvis. It is possible that these morphologies could be impacted by urban living. Despite ongoing research pertaining to other environmental effects on sexual dimorphism, little research in understanding the potential relationship between nonmetric skeletal indicators of sex and settlement style have been attempted.

A cross-population comparative study of standard nonmetric sex indicators of the cranium and pelvis was performed to illuminate any patterns in sexual dimorphism due to urbanization. Two post-Medieval Dutch populations were examined; the rural Middenbeemster (n = 100) and the urban Arnhem (n = 99) collections. These groups were compared using the Tukey-Kramer method and Greene’s t-test to determine whether they differed in their degree of sexual dimorphism within and between the rural and urban samples. The results of this study indicate that the relationship between urbanization and sexual dimorphism is more complicated than initially hypothesized. There appears to be a reduction of sexual dimorphism in the glabella, supra-orbital margins, and mental eminence in the urban population, resulting in a shift towards the intermediate morphologies in both males and females. However, confounding factors suggest that more research with known populations is necessary to determine which aspects of urbanization are the cause of such variation.

This research opens discussions of how life history factors, including health, nutrition, stress, and disease, could significantly influence standard forensic and archaeological procedures and potentially contributes to the production of more accurate skeletal assessments in the future.
Archives reveal new information on a Later Stone Age cemetery at Grotte des Pigeons.

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The site of Grotte des Pigeons (Taforalt), Morocco, is known for its Later Stone Age Iberomaurusian burials, dating from about 15,000 until 12,600 cal BP. The burials were spatially distinct from habitation areas, and comprise the earliest well dated cemetery in Africa.

Excavations were carried out over several seasons from 1951-1955, and 28 multiple graves were recorded from adjacent contexts named Necropolis I and II, located in a north-eastern alcove and at the back of the cave, respectively. However a detailed description of the funerary behaviour at Grotte des Pigeons was never published.

In this study, we aim to reconstruct as much of the original burial context and funerary behaviour as possible by studying previously unpublished, and partially published excavation records from museum archives, including plans, photographs and field notebooks. All plans have been digitised and assembled to establish their spatial relationships and stratigraphic sequence.

The second stage of this project involves a reassessment of the skeletal material and aims to reintegrate the skeletal assemblage and archival information.

In some cases elements which were assigned to different burial contexts have been matched, allowing us to reassemble elements from the same individual, giving valuable information on the chronological sequence of burials and the number of individuals in the assemblage.

The archive data provides a basis for re-evaluating the diversity of Iberomaurusian burial practice at Grotte des Pigeons and how this changed over time.
Delayed development in an enslaved woman from Curaçao.

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The remains of a young woman of African ancestry buried in a wealthy 18th-century suburb of Willemstad, Curaçao, and excavated in the 1980s, have been analysed in order to investigate the physical experiences of enslaved women on the island for the first time.

We used historical, osteological, and isotopic evidence to examine her remains from a life history perspective. Isotopic analysis indicates that she probably spent her childhood in West Africa. Forced migration to the Americas probably then took place during her late childhood or early adolescence. Indeed, linear enamel hypoplasia at the same location on all third molars indicates that a stressful event occurred during this time. Her dental development (used as a proxy for chronological age) indicates that she was over 18 years of age at the time of death, while her stage of epiphyseal fusion indicates a non-adult biological age of 12 to 15 years. This developmental delay of at least three years could have been caused by several factors. Rugose muscle attachment sites, diffuse areas of subperiosteal new bone formation, large mastoid processes, and contour change at the occipitocervical joint indicate that hard labor (perhaps including the West African and Caribbean custom of carrying loads on the head) and infection could have influenced her physical development.

This study demonstrates the value of revisiting existing archaeological collections, allowing us to situate Curaçaoan enslavement in a real body and contributing to wider discussions on delayed puberty and its relationship with cultural and historical factors.
Shouldering the load: a comparison of rotator cuff disease prevalence and demography in three skeletal assemblages from the medieval (1066–1540 CE) and post-medieval periods (1540–1850 CE) in Britain.

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Rotator cuff disease (RCD) is a pathological condition that commonly occurs due to repetitive shoulder strains during activity, acute traumatic incidents or age-related tendon breakdown. Investigations into the causes, impacts and treatments of this disease appear frequently in the clinical literature, but unfortunately, palaeopathological studies of RCD are fewer in number and more limited in scope. As a result, our understanding of how this condition appears in archaeological contexts is somewhat fragmentary. This study sought to expand the body of palaeopathological literature on RCD by applying a revised version of the Waldron criteria for diagnosing RCD in skeletal remains to a sample of 137 medieval and 369 post-medieval skeletons from sites throughout Britain. Disease distribution and prevalence were determined and pathological changes at specific tendon insertion points were examined to explore how different areas of the shoulder were affected. In the medieval period site, 87/137 individuals (63.50%) exhibited changes in the rotator cuff muscle insertions, whereas the disease appeared in 203/369 (55.01%) of the post-medieval skeletons. The disease affected males in both periods more frequently compared to females, though prevalence differences between the sexes were less pronounced in the medieval individuals. Throughout all the assemblages assessed, the disease affected older adults more frequently and more floridly, which also reflected age-related distribution trends observed in clinical contexts. From these preliminary results, the analysis of additional archaeological sites and time periods is proposed to better understand the ways in which RCD pathogenesis, anatomical distribution and demographic profile may have changed over time.
Belgian Colonists in early 20th-century Congo; headhunters or curious doctors?

Anthropometrical and traumatological analysis of 14 Congolese skulls kept at the Université Libre de Bruxelles

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In February 2019, a symposium was held at the Université Libre de Bruxelles on human skulls from the colonial era kept in universities. The themes of restitution and repatriation being currently in the spotlight, we sought to study these human remains, fallen into oblivion for more than a century. We opted for a contextual research for this collection at the level of archives and publications, but also the establishment of a traumatological-pathological assessment of these individuals. We analysed 14 skulls collected in Belgian Congo and then offered to the university. Once collected, they sank into anonymity.

In our study, anthropometric measurements were made using colonial methods, accompanied by a morphological description, and a focus on the pathological and traumatic elements. We have thus highlighted signs of incisions that could corroborate the hypothesis of death by decapitation or decollation (analyses in progress). Other skulls exhibit pathologies that could have made Belgian doctors bring them back to Belgium as an example for university students. Some skulls display traces of ink writing, almost illegible, which had to be deciphered. By searching through the Journals and Archives of colonizing soldiers and doctors who accompanied them, we were able to find the skull of an individual whose decapitation was recorded in a personal journal, and the photo published in a published Colonial Review in Belgium. We hope to be able to identify all individuals, and to inscribe this collection in a perspective of reflection on the existence of colonial human remains in universities.
Nutritional deficiency indicators in 19th century human skeletal remains from St Mary’s Cemetery, South Australia.

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2. Flinders University, South Australia.

The nutritional health status of 19th century British immigrants to South Australia have never been studied. Therefore, the aim of this study was to investigate the prevalence of vitamin C and D, and iron deficiency in 19th century British settlers, who were buried in the lower socioeconomic area of St Mary’s Anglican Church Cemetery, South Australia. Skeletal remains of 65 individuals, (20 adults and 45 subadults) from St Mary’s were studied. Pathological manifestations caused by vitamins C and D and iron deficiency on bone were identified by macroscopic examination. Micro-CT scanning was conducted on one tooth from each of nineteen individuals to identify interglobular dentine, which is an indicator of the failure of matrix mineralisation. Results showed one case of abnormal porosity of the cortices of multiple bones and one case of flaring of the distal metaphysis of the femora seen among the subadult skeletons. Two adults and one subadult displayed interglobular dentine. Bilateral abnormal porosity of the orbital roof was seen in three subadult skeletons. Prevalence rates of individual pathological manifestations were similar to those reported for a 19th century sample of lower socioeconomic status individuals, buried at St Martin’s Cemetery, Birmingham, England. The socioeconomic status of British migrants affected their access to the basic requirements of nutrition, showing that migration to a country with better climatic conditions did not improve the nutritional health of early British settlers in South Australia compared to their contemporaries in Britain.
The evidence for smallpox in the archaeological record: a case from the Saxon site of Soham, Cambridgeshire.

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Smallpox, caused by the viruses Variola major or minor, was a widespread, highly contagious and often fatal disease prior to its eradication in 1980. Skeletal manifestations (osteomyelitis variolosa) are uncommon, affecting as few as 2-5% of infected individuals. Bony changes are short lived, non-specific and occur only in subadults. A study of published literature on smallpox confirms that the disease is hard to identify in human remains and the archaeological record is, as a result, sparse and fragmented.

The aim of this paper is to contextualise a possible case of smallpox from the Saxon period in a skeleton aged 5-6 years at the time of death. This was excavated by Archaeology South East (UCL) in Soham, Cambridgeshire, prior to a housing development. The skeletal changes observed in skeleton [2639] consisted of bilateral involvement of the bones of the upper and lower limbs which displayed thick deposits of porous and striated new bone formation covering most areas of their diaphyses. The severe damage produced to the elbow joints led to their deformity and ankylosis. In line with the clinical and palaeopathological literature the pelvis and the spine were not affected. Little is known about how prevalent the condition was and how it was treated during Saxon times. It is therefore hoped that this case study will contribute to the body of knowledge of viral infections in palaeopathology and will build upon the evidence for smallpox which is dispersed within the archaeological literature.
Mastication in British history: a 3D geometric morphometric analysis of human mandibular variation over time in Britain in relation to dietary and masticatory changes.

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The human mandible has become more gracile over time, these morphological changes have been linked to large scale dietary transitions such as the advent of agriculture and industrialisation. During these transitions changes in dietary consistency are thought to have been brought about through developments in food processing and cooking technologies as well as the increased reliance on carbohydrates, resulting in a softer diet that would have required less mastication. As masticatory strain decreased mandible morphology has become more gracile through alterations in bone remodelling. However previous studies have typically focussed on the comparison of two periods associated with large-scale dietary changes, as such it is not known how susceptible the mandible is to minor changes in diet.

The aim of this study is to fill the current gaps in the literature by analysing how mandible morphology has changed in Britain from the Neolithic through to the Post-Medieval period. 777 mandibles were 3D scanned and landmark based geometric morphometric analysis was conducted with Canonical Variate Analysis utilised to determine how mandible morphology varied between the six time periods analysed in this study. Results determined that in general mandible morphology became increasingly gracile over time, with more pronounced changes occurring between the Neolithic and Iron and Bronze Age thought to be associated with the intensification of arable agriculture. In addition, significant increases in gracilisation occurred between the Anglo-Saxon and Medieval and also the Medieval and Post-Medieval periods likely related to increased urbanisation, modernisation and industrialisation of food processing technologies.
All the girls, and all the boys: exploring sexually dimorphic growth profiles and growth disruption in a documented 20th century fetal and infant skeletal collection.

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Evaluating the growth of non-adults for the purposes of age estimation has long been an anthropological concern, with growth standards developed using both documented and archaeological samples. The majority of available age estimation methods are based on pooled data from both males and females due to the problems of determining sex in non-adults, and most focus on individuals over the age of one-year. This study aims to examine growth and evidence for growth disruption in males and females from a documented infant and fetal skeletal sample.

Analysis included a total of 132 individuals (71 males and 61 females) aged 13 gestational weeks to 7 months post-partum curated at the Smithsonian Institute. Forty-eight individuals had documented ages, and 54 individuals had dentition available for assessment. Skeletal growth profiles for the femur, tibia and humerus were developed and, where possible, compared to both dental and documented age. Results confirm that dental development can be used as a proxy for chronological age within this population. However, females were found to have more advanced dental development for gestational age when compared to males, resulting in over-estimations of age-at-death. Overall, females were also found to have more regular and linear growth trajectories, whilst the males exhibited greater variability for all three limb elements. For the males, age-at-death estimates based on diaphyseal length were found to consistently underestimate age.

This study contributes to the ongoing discussion of the variables influencing growth in the early life course. It highlights the significance of biological sex for archaeological assessment and interpretation of age-at-death. Finally, it is relevant for considerations of early life plasticity and the developmental origins of health and disease.
A bioarchaeological study of entheseal changes and women’s activity in medieval Edinburgh, Scotland.

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Entheseal change (EC) morphology has been used within bioarchaeology to reconstruct behaviours of past peoples but ECs are known to have a complex and multifactorial aetiology. Research on identified collections requires documented occupation, but females are often excluded due to the use of non-specific terms.

This study of 90 female and male skeletons dating from the medieval period (11th-16th centuries) in Edinburgh, Scotland explores skeletal changes associated with occupational activities. The research incorporates the socioeconomic history of medieval women and takes a broad approach to the analysis of occupation and activity in archaeological collections by including palaeopathological diagnosis, age, the new Coimbra Method for EC scoring, asymmetry, and biomechanics. Preliminary results confirm higher Coimbra EC scores with increased age over 50 and the lowest EC scores for individuals under 30. While scores are higher in males, females have similar prevalence rates. Of those with right/left asymmetry, females had higher EC scores on the right while males were higher on the left. The true prevalence rate (TPR) for ECs and degenerative joint changes were significantly similar at only one joint and otherwise there was no association between the two sets of scores.

Future research directions involve increasing sample size to 250, cross-sectional analysis of 3D scanned humeri, and a biomechanical case study with living volunteers performing one historic occupational activity. This research can help us to better understand the complex aetiology of ECs and is developing approaches to study females, unknown skeletal collections, and the biomechanics of archaeological activity.
Evidence that mercury treatment leaves an elemental signature in enamel and dentin during dental development.

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Archaeological studies have used chemical analysis on human remains to evaluate possible exposure to heavy metals and the use of heavy metal treatments. Mercury was used to treat venereal disease prior to the introduction of penicillin, including in Australia. This study investigates whether mercury leaves an elemental signature within enamel and dentin in those who demonstrate dental abnormalities associated with mercury treatment used to treat congenital syphilis.

The individual in this study is a male subadult aged between 8 to 10 years who was uncovered from St Marys cemetery in Adelaide, Australia, dating from the mid-19th to early 20th century. The individual demonstrates dental signs attributed to congenital syphilis and mercury treatment. Laser ablation was conducted on four areas of the right mandibular first permanent molar to detect levels of mercury.

Elemental signatures of mercury were detected, ranging between 2.89ppm to 9.84ppm in the dentine in comparison to 0.03ppm to 0.92ppm in the enamel. High levels of arsenic were also detected in the dentine, ranging between 1.35ppm and 6.27ppm.

Elements leave a signature within enamel and dentin during dental development. It is not surprising to find levels of mercury and arsenic in the same location as both were often used in conjunction with each other to treat congenital syphilis. Mercury treatment ranged from two to ten grains (= 129598µg to 647989µg), which exceeds the tolerable intake of methylmercury for children, 1.6µg (= 1.6ppm) per kilogram of bodyweight per week. This supports that toxic levels of mercury produce specific dental abnormalities.
Making the invisible visible: test of a population-specific approach to non-adult sex estimation using permanent odontometrics on a post-medieval Dutch skeletal collection.

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Sex estimation of non-adult skeletal remains has long been regarded as a problematic or even an unattainable objective within physical anthropology and forensic science. The present research used the post-medieval documented skeletal collection of Middenbeemster, the Netherlands to test a population-specific statistical approach based on the crown and cervical diameters of the permanent canines and maxillary first molars. The odontometrics of the adult component of the population (n = 76) were used to develop 14 logistic regression formulae, which were subsequently applied to the non-adult individuals of the same population (n = 15). Though the two formulae based on the maxillary first molar odontometrics performed little better than chance, all 12 of the formulae based on the permanent canines achieved accuracy rates above 75%, with eight surpassing 85% and five achieving 100% accuracy. It was demonstrated that as little as one dimension of the permanent maxillary or mandibular canine can be used to estimate sex with an acceptable level of confidence. A reliable technique to estimate sex in non-adult osteological remains would contribute greatly to the field of osteoarchaeology, allowing for the refinement of osteological age estimation and growth studies as well as more perceptive interpretations of the social, economic, or environmental implications of osteological evidence such as differential morbidity and mortality rates. By allowing reliable sex estimation in non-adult skeletal remains, this method makes it possible to gain insights into the past lives of non-adult individuals, who all too often seem invisible in archaeological and historical narratives.
A case-review study to assess the variables that influence the degree of mummification and skeletonization in a modern USA population.

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Taphonomic studies through experimental research at Forensic Anthropological Research Facilities are continuously developing our understanding of soft tissue decomposition in controlled environments. A substitute are photographic archives, an often ignored invaluable resource. These photographs may only depict a cadaver’s decomposition state at time of discovery and/or subsequent autopsy however, detailed case notes, environmental variables surrounding the death and (if known) PMI are available. Leccia, Alunni & Quatrehomme (2018) utilised this resource to calculate total body surface area (TBSA) in cadavers with extensive and complete mummification using “the rule of nines”, a method where the body is sectioned into nine segments to assess TBSA burnt, without statistical testing.

This paper aims to revise their study by implementing the more representative Lund and Browder chart (Yasti et al., 2015) to visually assess all degree of mummification and skeletonization, through a secondary data analysis study using autopsy photographs of 17 cases from Allegheny (Allegheny County Medical Examiner’s Office, Pittsburgh, between 2007–2016). Principal component analysis (PCA) was conducted on the body section scores to reveal high correlation co-efficients (>0.95) between sections indicating a high confidence, the decomposition traits on multiple body parts will co-exist on a decomposed body. PCA of recorded variables revealed that after body location was removed from analysis, the majority of variables had strong values. Multiple regression analysis and ANOVA revealed the constant and age to be significant variables. This study demonstrated the need for greater sample sizes whilst also encouraging further examination of controlled variables in multiple global environments.
A tooth for a tooth: dental oral health indicators in Middle Bronze Age populations in the Eastern Delta and the Levant.

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Examining several indicators of oral/dental (dental caries, antemortem tooth loss, dental calculus, and dental attrition) and physiological (linear enamel hypoplasia) health, this study is part of a larger interdisciplinary project that aim to reveal the origin of the Middle Bronze western Asiatic population of Hyksos in Egypt. Nevertheless, the Hyksos phenomenon has therefore mainly been studied by text-based Egyptology, ignoring other biological data. Henceforth, two human skeletal assemblages are investigated: 1) Tell el-Dab’a (n=70), located in the Nile delta region of Egypt where Avaris, the capital city of the Hyksos, once stood 2) Sidon (n=113), a coastal city, on the southern coast of Lebanon. Our main objectives are to 1) document, for the first time, indicators of health in Sidon and Tell el-Dab’a skeletons, 2) examine differences between male and female skeletons, 3) compare health between the two contemporary populations, and 4) place the skeletons from both sites in a broader regional perspective. Most differences emerged when comparing the prevalence rates of dental oral health indicators in subadults and adults between the contexts. Contrary to expectations, no significant sex differences in the frequencies of these indicators were found in the studied series. With the exception of significantly higher frequencies of dental calculus in the two series, the overall dental health of Tell el-Dab’a’s population was slightly better than the Levantine one from Sidon. Our results allow us to pinpoint similarities and differences between Egyptian and Near Eastern skeletal samples helping better identifying each population.

This project has received funding from the University of Bournemouth and from the European Research Council (ERC) under the European Union’s Horizon 2020 Research and Innovation Programme (Grant Agreement No 668640).
Estimation of sex from the petrous bone – a comparison of existing methods.

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Studies of cremated human skeletal remains show that the petrous part of the temporal bone often survives the burning process due to its dense and robust structure. Because of its frequent occurrence and good preservation in skeletal material from both archaeological and forensic context, several methods for sex estimation have been developed for this specific skeletal element. As these methods affect the quality and quantity of information about the deceased individual, the most commonly accepted techniques were reviewed and tested on a mixed sample of recent forensically and archaeologically derived material. The methods applied included the assessment of five morphological traits as well as the measurement of eight variables on a total of 66 cremated and 38 uncremated petrous bones. In addition, the lateral and medial angles of the internal auditory canal were also measured on casts, using dental casting material on a sample of ten uncremated temporal bones. It was found that the metrical approach is highly depending on the morphological characteristics of the defined landmarks and that the inter- and intraobserver errors are highest for both angle measurements. The results show that these methods are highly susceptible to false application, suggesting that a combination of certain criteria and an improvement of the applied techniques enhance the outcome for the estimation of the individual’s sex.
Isotope analysis reveals varied diet amongst late Anglo-Saxon residents of Godalming, Surrey.

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Priory Orchard, Godalming, Surrey, is a late Anglo-Saxon to Anglo-Norman (ninth to twelfth century) cemetery excavated during 2014-15. The >300 distinct internments exhibit variable preservation, due to acidic soils. As the population straddles two key early medieval transitions – the ‘fish event horizon’ and Norman Conquest – stable isotope analyses were performed on postcranial bone to investigate dietary intake and variation.

Bone fragments from 93 individuals (plus fauna) have been analysed for dietary stable isotopes. Bone collagen was processed at the Dorothy Garrod Laboratory, University of Cambridge, following a modified Longin method. Samples were run in triplicate where possible, and values are reported relative to the VPDB (δ\(^{13}\)C) and AIR (δ\(^{15}\)N) standard references. Analytical error (1σ) for all collagen samples is ±0.20‰.

Preliminary results suggest that the population consumed a terrestrial-based diet of C3 plants and animal protein. Half of the individuals display nitrogen values consistent with higher consumption of animal protein (relative to faunal baselines), which could indicate consumption of pigs and/or freshwater fish. There is no overall pattern in relation to sex, although the individuals with the highest nitrogen values are male (or of unknown sex), which may suggest some social stratification not seen in earlier Anglo-Saxon populations. Juveniles (4-16 years, n = 3) display some of the lowest nitrogen values. Consistent with these observations, caries appears to be more prevalent in the group with lower nitrogen values. Additional mobility isotope, bacterial (dental calculus) and mitochondrial aDNA analyses are underway to better characterise this unique medieval population.
Improving the definition of root formation stages.

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Root stages of developing teeth are used to estimate age but difficulties arises when a tooth appears to be midway between stages. The aim of this study was to combine tooth length with root fractions to improve the subjective assessment of immature roots.

**Materials and methods** Isolated maxillary central incisors (N=96) and mandibular first molars (N=127) from juvenile modern human skeletal remains were assigned into Moorrees et al.’s formation stages and maximum tooth length was measured. Mean tooth length values of root complete, apex half closed and apex closed were compared using ANOVA of these teeth. Average tooth length of root quarters were calculated from the average values of mature root length for both tooth types.

**Results and discussion** Tooth length of root complete, apex half closed and apex closed of these teeth were not significantly different and data for these stages were combined. Expected tooth length of root fractions calculated from the average mature root for these tooth types provide guidance.

This quantitative approach partly overcomes the subjective nature of estimating root stages of developing teeth, however, individual variation in mature tooth length remains a difficulty when assessing immature roots.
Thermal alteration of cranial shotgun defects: trauma identification and alteration caused by forensic cremation.

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Previous studies on thermal alteration of gunshot wounds focused on single projectile defects, primarily from handguns. Cortical delamination obscuring entry and exit beveling, and shrinkage of the defects were observed in experimental studies. Research into multiple projectile defects has not been conducted. This study will assess the changes to both the penetrating defects as well as the associated blunt force trauma of shotgun wounds to establish a baseline for differentiating peri- and post-mortem fractures and changes in defect size.

The sample consists of 15 adult sheep crania in a semi-fleshed state. Shotgun defects were created with No. 6 birdshot and 00 buckshot at close range. Six specimens from each shot type underwent partial cremation to preserve the wound characteristics for analysis while one cranium for each underwent full cremation for preservation comparison. A control specimen underwent partial cremation with no defect to create a baseline for venting. All cremation simulations were done without accelerant in an outdoor simulation.

Expected results for the No. 6 birdshot is to underdo defect shrinkage similar to the single projectile defects while the 00 buckshot is expected to react similarly to blunt force trauma, due to the crush injuries around and between the defects, causing inward expansion. Full results completed by July 2019.

This study will create a forensic baseline to assess multiple shot defects ensuring shotgun wounds can be distinguished from other trauma profiles after thermally altered. Further research is required to establish criteria for the effects of agitation during cremation and of accelerants.
Knife + heart? A case of unusual peri-mortem thorax trauma from St. Michael’s church, Workington, Cumbria.

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Archaeological works undertaken by Carlisle Archaeological Unit from 1996-7 at the parish church of St Michael, Workington in Cumbria, recovered evidence for a pre-Norman church, its 12th century reconstruction, and subsequent phases of enhancement, all associated with burials.

A total of eighty skeletons were analysed osteologically by Oxford Archaeology. Perhaps the most unusual individual from the St Michael’s assemblage is skeleton 300, a 25-35-year-old man buried in a large, well-constructed cist on the south east side of the pre-Norman church, and radiocarbon dated to 1015-1040 cal AD. Detailed palaeopathological analysis shows this individual had congenital malformation of the jaw (causing a slight facial asymmetry), a complex pattern of healed ante-mortem injury and subsequent infection in the left arm, and most notably, evidence of peri-mortem sharp-force trauma to several bones of the right clavicle, manubrium, and the third and fourth thoracic vertebrae. The latter evidence is consistent with the individual suffering at least four blows to the upper right chest with a sharp-bladed weapon. These injuries are likely to have been fatal. Moreover, the close positioning and angle of the injuries may suggest that three of the wounds, if not all, had occurred when the man was incapacitated, lying on his back.

This paper will detail and discuss the palaeopathological evidence in the context of other examples of peri-mortem sharp-force trauma, described in the clinical, forensic and anthropological literature.
“Fake Olds!” Osteoarchaeological analyses to correct older narratives based on invented radiocarbon dates.

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2. Stiftung Ruhr Museum, Germany.

In 1972 human cranial remains of ca. 18 individuals were collected from a construction site in Haan, Germany. Some were still associated with a peculiar, ring-shaped metal headgear which had led to the partial preservation of hair and textiles. The skulls were subjected to various analyses, including repeated radiocarbon dating, e.g. at the University of Frankfurt. Based on that and the expertise of recognised experts a narrative was constructed which identified the crania as those of 10th century elite canonesses which fled the destruction of their abbey by Hungarian marauders, a feared scourge of that time. Since the 1970s this narrative was presented as part of the regional history in various publications and the local museum.

In 2015, during research for an exhibition in the Ruhr Museum the present authors first encountered this narrative, quickly identified inconsistencies and initiated a new round of integrative research, including a thorough osteo- and funerary archaeology assessment, AMS radiocarbon dating and micro x-ray fluorescence of the bones and artefacts. The new results firmly date the assemblage to the 17th/18th century, consistent with the newly established historical interpretation of the headgear as Ohreisen or oorijzers. These were ubiquitous elements of female attire throughout the Rhine area until the mid-19th century but were later quickly forgotten about. The present research re-establishes knowledge about their funerary use and identifies further radiocarbon dates apparently freely invented at the formerly existing Frankfurt radiocarbon facility. Multiple radiocarbon dates of the same laboratory were already exposed as fake in the past.
Stave, staff or stick? - burials and belief in a medieval Carmelite church site, Perth, Scotland.

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Of over 300 burials excavated at the Carmelite church site of Whitefriars in Perth, Scotland, 20 individuals were found associated with wooden staffs. Staffs, also termed rods and even wands, are a relatively uncommon grave good in otherwise Christian burials of the time. The staffs themselves are long and fashioned from ‘green’ wood; usually from ash, willow or hazel. A range of interpretations for their presence from healing to protection (including putative magico-religious connotations) have been proposed. The aim of this paper is to develop a biological profile for each staff burial and explore the identity of these individuals and this practice of staff burial in general. Materials included ten of the better-preserved staff burials, while the methods undertaken included sex, age-at-death and stature estimation using BABAO standards in addition to a complete palaeopathological examination of each case. Initial results indicate an age range of between 35 and 50+ years, with all individuals showing some sign of healed trauma, infectious disease and or significant age-related skeletal changes (e.g. osteoarthritis). Conclusions focus on a discussion as to whether the presence of the staffs may be driven by a perceived healing or protective property. Ultimately, this research contributes to our interpretations of a more unusual mortuary practice in Medieval Scotland, and discusses its clear links with similar practices in Scandinavia.
War, wounds, and medicine: a re-examination of the men of the Mary Rose.

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The infamous sinking of the Mary Rose in 1545 was responsible for claiming the lives of approximately 400 crew members. A full excavation of the ship and her contents took place in the early 1980s from which many human bones were uncovered, along with an intact medical chest. Initial work undertaken in the 1980s attempted to sort through the co-mingled remains and, where possible, reunite the bones of individuals. This revealed remains representing at least 179 individuals, including 92 Fairly Complete Skeletons (FCSs). However since this initial study, very little has been done on the human remains from the wreck.

This study re-examines the FCSs from the wreck of the Mary Rose, focusing on any pathology that may have resulted from being a crew member on board a war ship. The Mary Rose provides a rare opportunity to examine the remains of men where the context in which they lived and died is known. Additionally the presence of the medical chest also provides a unique insight into what tools the ship’s surgeon would have had at his disposal for treating those injured on board. By combining the analysis of the human remains and the medical chest uncovered from the wreck, along with the study of contemporary Medieval medical texts, it is hoped that a better understanding can be gained of the practice of naval surgery in the sixteenth century, and whether or not surgeons on board war ships would have been adequately equipped to fulfil their duties.
‘Mrs Grieve’. The isotopic and osteological story of a teaching skeleton.

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1. University of Bradford, UK.

**Aims and objectives** ‘Mrs Grieve’ is a teaching skeleton in the collection at the Old Operating Theatre Museum, London, named after the herbologist, Maud Grieve. Through her skeletal remains we reconstruct the life of this individual and the impact of socio-economic issues, regulatory laws and policies on the trade in human remains.

**Material and methods** Osteological analysis and carbon (13C/12C) and nitrogen (15N/14N) stable isotope ratio analysis of her M2 tooth were carried out, constructing a 3D print of the tooth to return to the museum display. The company stamp on her pelvis became the starting point for research into the trade in human remains.

**Results** Analysis revealed this individual was female, of European ancestry, who died as a young adult. Lesions on her skull suggest a diagnosis of syphilis: cut marks on right humerus and femur indicate defleshing. The lack of craniotomy suggests she was significantly decomposed by the time she was obtained for teaching purposes. Results from the isotope analysis show that she consumed a diet of mainly marine sources, suggesting she was not local to London. Research into the company stamp shows she was sold between 1884-1932.

**Discussion** This study allows us to reconstruct some of the life history for this anonymous individual which was lost when she became a teaching skeleton, and provides the Old Operating Theatre Museum with information which brings her value for teaching about the history of medicine right up to date.
An investigation into the prevalence of vitamin D deficiency in a 19th century London population.

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Evidence shows the prevalence of rickets amongst urban children dramatically increased during the 19th century in England, as a result of overcrowding, pollution, and poor diet. However, the identification of the condition in the archaeological record is limited due to remodelling of bone over time, and poor preservation of non-adult remains. Recent research has found significant differences in pulp horn morphology in those with vitamin D deficiency, suggesting that radiographic analysis of teeth may be used as a screening tool to identify deficiency disease.

This project aimed to assess the macroscopic and radiographic evidence for vitamin D deficiency within a 19th century urban population group, in order to increase the understanding of the prevalence of childhood deficiency during this period.

To investigate this, individuals were acquired for analysis from New Bunhill Fields, Southwark, a 19th century London burial ground in use between 1821-53. This burial group consists of 514 individuals, 357 non-adults and 157 adults. Macroscopic cases of rickets within this burial group have been confirmed at 20. No cases of residual rickets or osteomalacia have been identified. Radiographic assessment is underway to identify non-adults and adults with changes in pulp horn morphology associated with vitamin D deficiency during dental development. Radiographic results are pending.

This innovative technique has the potential to identify periods of childhood vitamin D deficiency in cases where the bone has since re-modelled and skeletal evidence is lost. This will allow us to assess whether vitamin D deficiency was as prevalent during industrialisation as previously thought.
Care of the children: an introduction to composite life course analysis of non-adults in England c. 1450-1600.

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Bioarchaeology of Care analysis has the potential to inform us about a multitude of childhood experiences in the past; such as sociocultural practices, dis/ability, caregiving, parenting, community provision, medical treatment, etc. Care analysis has proved a valuable tool for interpreting the effects of advanced pathological skeletal manifestations on individuals lives, however, such analysis has been predominately focused on adult case studies. This analysis aims to present evidence of non-adult care, though the adoption of new theoretical ways of interpreting care within the wider population. This interdisciplinary study contextualises the care of children in later medieval and early modern England. Data from a total of 4,091 non-adults from 158 sites were collated from published and unpublished skeletal reports and analysed for evidence of skeletal changes indicative of progressive infectious morbidities of tuberculosis, leprosy, and treponematosis. A composite life course approach was adopted in which the evidence was interpreted in relation to age, disease onset, disease progression, and care provision. It was observed that adopting a life course approach emphasized the significance of age in relation to care during childhood. Utilizing the composite life course approach presented new ways of considering the lived experience of morbidity and care in the past.
Approaches to cranial phenotypic diversity in past populations: a case study of the Lankhills late-Roman cemetery.

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While useful in forensic anthropology, craniometric classification software such as CRANID (Wright 2012) and FORDISC (Ousley and Jantz 2005) do not produce satisfactory results when analyzing unknown crania in archaeological populations, as they attempt to classify past people into a mix of ancient, medieval, and modern ancestral groups. This paper responds by presenting a different approach to studying craniometric variation in archaeological populations, illustrated through a study of the late-Roman cemetery at Lankhills, Winchester. This approach uses K-means clustering based on Euclidean distance to explore and quantify the diversity within and between groups of crania. The results are compared with those of CRANID6 (Wright 2012). K-means clustering revealed significant phenotypic groupings in the Lankhills cemetery, and identified one significant morphological outlier (X²=14.909, p=0.0001). In contrast, CRANID6 classified 52.5% of individuals into a variety of different ancient and medieval European reference groups, 27.1% of individuals into many modern, ancient, and prehistoric Asian, African, and South American reference groups, and could not classify 18.6% of individuals. K-means clustering was able to quantify intrinsic patterns in phenotypic variation throughout the cemetery independent of, and therefore unbiased by, assumptions based on extant samples whereas the relevance of the classifications offered by CRANID6 is limited. This paper argues that K-means clustering based on Euclidean distance is better suited to exploring about diversity in the past, and offers more effective complementary data than CRANID6 for multidisciplinary studies which integrate ancient DNA, stable oxygen and strontium isotopes, and evidence of foreign and native identities through material culture.
A method for estimating age of juveniles based on long bone length from UK skeletal material.

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Objective To develop a series of regression equations for estimating age from length of long bones for archaeological juveniles when aging from dental development cannot be performed.

Material and Methods Skeletal juveniles (n=94) from two UK collections, Black Gate, dating to circa 8th-12th century and York Barbican, dating to circa 11th-14th century were odontologically aged. Linear regression formulae were produced for long bones. It was tested if the regression model could be improved by applying a quadratic model. We also estimated the age from the femur length (n=49) using equations based on radiographs of the femur in a modern population, and on an archeological data set with known ages.

Results Comparison between estimated ages revealed that the modern data result in lower estimated ages, while the estimated ages using the archaeologically-based equations were very similar to ours.

Discussion Our results suggest that equations based on modern data sets will almost certainly tend to under-estimate age. Modern data sets not only represent juveniles with different growth trajectories due to better health conditions, but also represent living juveniles, while we wish to apply the age estimate to non-surviving juveniles.

Conclusion We present regression equations for estimating the age of juveniles based on the length of long bones. These equations will be applicable for juvenile skeletons where dental development cannot be ascertained or to assess age-appropriate growth at the time of death, and will likely provide estimated ages closer to the chronological age, than using methods from modern data.
Visualising mastoiditis with a portable X-ray system – a preliminary analysis.

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We aim to develop a new method for diagnosing archaeological cases of mastoiditis that is grounded in modern clinical practices, non-destructive, and accessible; to expand the understanding of mastoiditis’ epidemiology and etiology and its impact on public health. This preliminary analysis will 1) assess the diagnostic quality of the X-rays generated and 2) compare the frequency of mastoiditis in the sample with that of other indicators of respiratory tract infection. A sample (n=40) from Black Gate cemetery, Newcastle-upon-Tyne, England (8th–12th century C.E.) were studied. Complete (unfractured post-mortem) mastoid processes were imaged latero-medially, postero-anteriorly, and inferio-superiorly using a NOMAD Pro Hand-Held X-ray System. Digital X-rays were visually analysed for evidence of chronic mastoiditis: lytic lesion(s) with sclerotic border(s). Individuals were visually examined for lesions indicative of chronic maxillary sinusitis and lower respiratory tract infections. Maxillary sinuses were examined via post-mortem fractures in the sinus walls. Fifteen percent (6/40) of the sample had lesions indicative of mastoiditis. Of these, 33.3% (2/6) and 16.7% (1/6) of the individuals also had lesions indicative of maxillary sinusitis and lower respiratory tract infection, respectively. The digital X-rays were found to have high fidelity, allowing for detailed examination and effective diagnosis. The percentage of individuals with mastoiditis is low, but within the range reported from other archaeological populations (2.0%–83.4%). Its co-occurrence with other indicators of respiratory tract infection suggest broad environmental risk factors, such as poor air quality, were influencing the population’s morbidity.
Enamel hypoplasia at the medieval sites of the Hirsel and Guildhall Yard.

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Linear enamel hypoplasia occurs when stress interrupts the formation of enamel. These defects do not remodel and as such are a useful tool for examining the childhood health of archaeological populations. It is often found that one social group will show a higher rate of hypoplasia than another, which allows for insights into the original living population. This study assessed patterns of mortality and rates of enamel hypoplasia at two British medieval sites: the Hirsel in southern Scotland, and Guildhall Yard in London. The Hirsel is a small, relatively isolated town, while Guildhall Yard lies at the heart of a large urban center. The differences in the physical and social environments were expected to result in the populations being affected by different levels of stress.

A sample of 70 individuals from the Hirsel was selected for comparison with data for the 69 individuals from Guildhall Yard available through the Wellcome Osteological Research Database at the Museum of London. The canines and central incisors were examined for enamel hypoplasia. The prevalence of enamel hypoplasia across the population, and between individuals of different age and sex, was assessed. The prevalence of enamel hypoplasia was greater at the Hirsel, where infant mortality was also higher than at Guildhall Yard. There were slight differences in mortality rates between males and females, with young adult females more at risk in both groups. The difference between these two populations suggests that the environment at the Hirsel resulted in a higher level of childhood stress.
Robertson, Emma

The deformity of fashion – evidence of plastic changes related to tight lacing from the 19th century cemetery at New Covent Garden (NCGM), London borough of Wandsworth.

Robertson, E. 1

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Intentionally altering the natural form of the body to follow a fashion ‘ideal’ is a long-standing cultural phenomenon, from the extremes of foot binding and skull deformation to the introduction of foreign items through piercings and tattoo ink. Gaining the ‘perfect’ silhouette occasionally required more than diet and exercise. The corset is a western example of modification used to create the physical form considered ideal by fashion; design, length of wear and fit will all have contributed to the level of plastic changes observed.

The cemetery associated with the church at NCGM was in use from late 1820’s to early 1870’s. During this period the corset evolved, initially becoming less restrictive in the early 1800s before reverting, during the Victorian period, to create the constricted waist and ‘hourglass’ figure.

This work aims to contribute to the existing studies. Plastic changes to the skeletons of 10 individuals from the NCGM assemblage demonstrate vertebral malformation and varying degrees of rib angulation and shape alteration. Three individuals present a distinctly flattened sternum (not previously reported in other studies) which may have resulted from a ‘busque’ or ‘busk’; a rigid element of the corset that was designed to keep the front straight and upright. Of particular interest is an elderly female with sclerosis and remodelling related to a prolonged irritation possibly in response to an ill-fitting corset; however, these ‘bed sore’-like lesions could be just that, caused by an extended sedentary period spent within a bed or chair.
In investigating lifecourses in medieval Cambridge through multi-tissue dietary isotope analysis.

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The After the Plague project aims to investigate Medieval life in Cambridge, particularly focussing on the effects of the Black Death in 1348-50. Research presented here investigates dietary trajectories across the lifespans of various different groups who lived in Medieval Cambridge, through the analysis of carbon and nitrogen stable isotopes in multiple skeletal tissues.

c.275 rib and c.150 dentine samples from five sites in or around Cambridge, UK, were analysed for Δ¹³C and Δ¹⁵N. All dentine samples were taken from the root of 2nd premolars or 2nd molars, representing diet between approx. 7-12 years. Ribs are assumed to represent diet in the last few years before death.

Most sites appear to show on average a difference of >0.2 ‰ between dentine and rib Δ¹⁵N, which could indicate that dietary change through life was present across Cambridge. Further comparisons of trends in dentine and rib isotopic values reveals differential patterns in diet between childhood and adulthood in different groups, which is likely to be linked to social status e.g. monastic vs lay communities. Comparisons also reveal individuals who underwent considerable dietary change during their life, particularly those buried at the Augustinian Friary. Intriguingly, preliminary results indicate that trends in the relationship between dentine and rib isotope values may change after the mid 14th century, which could be related to contemporary influential events, including the Black Death.
Malaria in bone. Hunting for hemozoin.

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Malaria is known to have had—and still has—a massive impact on health. Although currently absent in the Netherlands, written records indicate that the disease was endemic, mainly in the Dutch coastal regions, from the 17th to the mid-20th century. It is likely that the disease was present in the medieval period as well, considering the environmental circumstances (e.g., low lying marshes and an high abundance of brackish water). However, as a result of the paucity of historical information concerning disease in this period, it is currently only speculative whether malaria was a medieval disease as well. This poster will present and discuss a new method to study the occurrence and impact of malaria in the medieval The Netherlands. This method, pioneered by Dr. Jamie Inwood at Yale University and further developed by the authors, focuses on the detection of hemozoin, a waste product of the parasite, using MALDI-TOF-MS (matrix-assisted laser desorption/ionization time-of-flight mass spectrometry). Results of the initial research, using synthetic hemozoin, various MALDI-matrices, and different solvents, show that high intensity signals of the characteristic 616 m/z peak can obtained at low amounts. This suggests that the improved protocol is an effective and efficient way to detect archaeological hemozoin as amounts in human skeletal remains are likely to be low. Future research will apply this method to medieval bone samples to detect malaria in skeletal remains and in doing so will be able to study the spread and impact of medieval malaria.
Human identification after death using skeletal remains is usually carried out through a series of examinations and observations that help with the estimation of biological sex. However, issues with these identification processes arise when the skeleton of the individual does not match the gender that they are presented as in everyday life. This study collated the literature and consulted with professionals from various disciplines related to transgender healthcare and human post-mortem identification, establishing their experiences and opinions encountered. In particular, the aim of this study was to investigate what issues may arise in the post-mortem identification process if gender transition took place before death, and what improvements could be made to the human identification process to minimise the number of individuals misidentified. The results suggest that there is a lack of specific training and knowledge regarding how gender transitioning may affect the human body. Therefore, this is an important issue as accurate identification is necessary. Furthermore, it is recommended that a central database for surgical implants and metalwork may improve identification, and as there is a lack of understanding in this subject, further research is essential.
Can a multi-isotope approach identify migration in the Second Intermediate Period?

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The Hyksos, Egypt’s first foreign dynasty, ruled between c. 1638–1530 BCE. Their origins are thought to be in the Near East, which is supported by architectural features and grave accoutrements of Tell el-Dab’a /Avaris. In this former Hyksos capital in the Eastern Nile Delta, burial culture is characterized by a blend of Egyptian and Near Eastern elements. However, investigations are still ongoing as to where the Hyksos came from and how they rose to power.

We present the findings of $^{87}$Sr/$^{86}$Sr and δ$^{18}$O of human enamel (n=71), established methods of identifying non-locals in archaeological sciences. Additionally, δ$^{13}$Capatite is used to attempt differentiating cultural groupings to identify migrants. We hypothesize that changing meal preparation and consumption practices would have been one of the last acculturation events, and thus differences in dietary isotope values as evidence of cultural groups will be observable at least in the earlier phases of the city.

Although $^{87}$Sr/$^{86}$Sr provided an intriguing picture of large immigrant input in Tell el-Dab’a, with significantly more early-period occupation individuals and females being recognized as non-locals, δ$^{18}$O and δ$^{13}$C provide confounding, nonsignificant results. The fact that those deemed non-local using strontium appear to come from a multitude of origins rather than a single homeland, along with shifting ‘local’ δ$^{18}$Odrinkingwater values over time due to damming, creates a difficult-to-interpret oxygen dataset. The similar menu between Egypt and the nonlocals’ homelands, posited to be in the Near East, may be the cause of a homogenous range of carbon values from the whole diet.
Digital futures for the physical past: investigating the use of photogrammetric modelling in the analysis and preservation of sharp force trauma.

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The continued development of technology is changing how human remains can be studied, curated, and presented to the public. A method of 3D digitisation known as Multi-View Stereo Structure from Motion (MVS-SfM) photogrammetry is currently underexploited in osteological research. It is a fast, inexpensive, and accessible way to create 3D models using overlapping images produced from multiple angles around a static object. For studies of skeletal trauma, this can potentially provide advantages in accuracy, precision, and repeatability compared to conventional physical measurements. Whilst techniques such as laser scanning and digital microscopy can create accurate 3D models, they are relatively expensive and time consuming. Currently, it is unclear how the quality of measurements from close range MVS-SfM is affected by changes in photogrammetric variables and the geometry of image capture. Therefore, this paper presents the results of a pilot study illustrating how best to use photogrammetry in the creation of detailed 3D models of incised sharp force trauma using the Weymouth Ridgeway Vikings as a case study. Additionally, this technique has the potential to be applied to other subject matter, such as pathologies, and therefore may present an invaluable resource for accurately digitising, studying and displaying aspects of human skeletal remains. The ability to have a preserved digital record may become increasingly important when remains are reburied beyond the reach of any further scientific questions.
Characterising and exploring patterns of cranial shape variation in recent Aboriginal Australians.

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Aboriginal Australians have a distinctive cranial shape compared to other global populations which, coupled with the early appearance of modern humans in the Australian archaeological record, has led to many questions about their population history. For example, the anthropological scholarship disagrees on the degree of isolation of Aboriginals since the initial colonisation of the continent and whether recent communities are the direct ancestors of the first settlers. Genomic evidence suggests recent groups have had a deep-time continuous occupation of the landmass; however, some morphological analyses have attributed variation to the differential admixture between multiple, largely successive, waves of prehistoric migration into Australia. This work uses previously collected 2D cranial measurements and 3D models to analyse patterns of Aboriginal cranial shape variation. Both craniometric methods and 3D geometric morphometric analysis were employed. Results suggest that there is interesting variation in the Aboriginal sample, structured spatially in a statistically significant way. Both 2D and 3D shape analysis methods found that facial prognathism and cranial vault shape are variable aspects of Aboriginal morphology. This mirrors the dichotomous variation observed throughout the Australian fossil record, supporting the genomic evidence that suggests that most modern groups are descended from a single colonisation event.
Trauma frequency and injury pattern in early medieval Säben-Sabiona, Italy.

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Trauma analysis yields essential information on human interactions, socio-cultural practices and levels of violence in past societies. Little is known on population dynamics in the northern Italian Alps that were crossed by Germanic cultures during the Early Middle Ages. An archaeological excavation in Säben-Sabiona, South Tyrol (Italy) exposed an early medieval church and cemetery (5th-8th centuries AD) indicating communal use by local (Roman) and non-local (Germanic) groups.

This study focuses on the reconstruction of bone injury mechanisms as well as their prevalence in early medieval Säben-Sabiona. Trauma was assessed through macroscopic and metric analyses. Both crude, injuries per individual, and true prevalence rates, trauma per bone, were calculated. The osteological remains (n=8044) of 226 Individuals have been studied to establish injury distribution and frequency. Two percent (130/8044) of the analysed bones and 17.7% (40/226) of the examined individuals featured trauma. The most common injuries were antemortem fractures on 58 bones, most of which were located on the appendicular skeleton (25/130), and perimortem sharp force trauma on 46 bones that were predominantly found on the right craniofacial region (10/130). Generally, each injured individual featured less than five traumata, however seven individuals account for 50% (65/130) of the observed lesions. With a 90.8% (118/130) incident rate, adult males exhibited significantly more trauma than females and subadults. The trauma investigation suggests that most of the injured buried in early medieval Säben-Sabiona experienced skeletal injuries associated with accidents and only a few, all of which were males, display signs of contemplated violence.
Peri-mortem saw marks on human remains from a parish cemetery in Koekelberg, Brussels, Belgium (19th – early 20th century AD).

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Excavations on the former parish churchyard of St. Anne in Koekelberg, Brussels (1833-1916), resulted in 14 burials and over 8,000 litres of disturbed bones, which included four bone fragments with peri-mortem saw marks. One adult and one non-adult cranial fragment showed indications for craniotomy, to gain access to the cranial cavity; while an adult mandibular fragment was sawed through, possibly to create a cross-section of the jaw. A distal tibia fragment showed saw marks on the proximal fracture surface, indicating it was the part which was cut away. While the saw marks in the skull bones were peri-mortem, it is unclear whether the tibia was cut when the person was alive or around the moment of death.

Craniotomy could be part of embalming, but considering the time period autopsy or dissection seems more likely. The marks on the mandible suggest dissection, while those on the tibia may indicate an amputation performed on a living person or medical training on cadavers. Indications for autopsies or dissections are not uncommon for post-medieval north-west Europe and have been recorded for several Belgian sites. While evidence for craniotomy is more common, saw marks on mandibles are not. Unfortunately there is no information on the archaeological context of the bone fragments and it is unclear whether they were originally part of primary depositions. The bones also show no pathological lesions which might offer an explanation. Their presence in the cemetery, however, does indicate a medical institution nearby.
Detection of early postmortem changes in burnt bones through histotaphonomical analysis.

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Introduction  The relatively few histological studies on burnt bone centre around estimation of age-at-death, maximum temperature, and species identification. In contrast, histotaphonomic studies have focussed on unburnt bone. Wedl-tunnelling (fungal attack) has been proposed to be an indicator of surface exposed and de-fleshed bones, while bacterial attack has been seen as a sign of putrefaction. Identifying either of these diagnostic characteristics on burnt bones could mean the body had decomposed to some extent prior to cremation, which would be important in both forensic science and bioarchaeology.

Materials and Methods  Fleshed Sus scrofa domesticus tibiae were left exposed on a field for varying amounts of time (fresh, 2 weeks, 1 and 3 months) before being cremated in an outdoor fire (>750 °C bone temperatures). Fresh (fleshed), decayed, and post-burnt bone thin sections were examined and compared under transmitted light microscopy. Diagenetic traits were quantitative assessed one-by-one and compared on the pre- and post-burnt sections. Histological structures were metrically evaluated to assess structural preservation in bones with varying collagen content prior to burning.

Preliminary results  Histological structures survived cremation. Previously described cyanobacterial tunnelling and Wedl type 2/enlarged canaliculi, thought to be caused by acid excretion from fungi, were observed on both the freshly burnt and decayed burnt bones. From this, it is increasingly likely that microscopic features, such as tunnelling and enlarged canaliculi, observed on unburnt and burnt bones that have been cited in the literature to be caused by bacterial and fungal bioerosion are, in fact, not due to such attack.
At the world’s edge: reconstructing diet and geographic origins in medieval Iceland using isotope and trace element analyses.


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Objectives A multi-isotope study was conducted on individuals buried at Skriðuklaustur monastery (AD 1493–1554) to investigate their geographic origins and dietary composition. Comparative material from individuals excavated from Skeljastaðir, an inland farm site was also analysed.

Materials and Methods Bone collagen was extracted from 50 humans (Skriðuklaustur and Skeljastaðir) and 25 animals (Skriðuklaustur) and analysed for δ\(^{13}\)C, δ\(^{15}\)N and δ\(^{34}\)S. Dental enamel samples from 31 individuals (Skriðuklaustur) were also analysed for \(^{87}\)Sr/\(^{86}\)Sr, δ\(^{18}\)O, δ\(^{13}\)C and trace elements (Pb, Sr, Zn, Ba).

Results The mean value determined from individuals from Skriðuklaustur (n = 36) was δ\(^{13}\)C = −18.7 ± 0.8 ‰, δ\(^{15}\)N = 12.8 ± 1.1 ‰ and δ\(^{34}\)S = 9.0 ± 1.6 ‰, whereas at Skeljastaðir (n = 14) it was δ\(^{13}\)C = −20.5 ± 0.8 ‰, δ\(^{15}\)N = 7.8 ± 0.9 ‰ and δ\(^{34}\)S = 9.4 ± 1.6 ‰. At Skriðuklaustur, human dental enamel samples (n = 31) provided a \(^{87}\)Sr/\(^{86}\)Sr range of 0.7060–0.7088, δ\(^{18}\)O\(_{\text{phosphate}}\) from 13.9 ‰ to 16.1 ‰ and δ\(^{13}\)C\(_{\text{carbonate}}\) from −16.6 ‰ to −12.9 ‰. Inferred drinking water (δ\(^{18}\)O\(_{\text{dw}}\)) values range from −12.3 ‰ to −8.9 ‰. Sr concentrations range from 25.8 to 156.7 ppm, Ba from 0.11 to 0.81 ppm, Zn from 43.8 to 145.8 ppm and Pb from 0.13 to 9.40 ppm.

Discussion A combination of results indicate that the people from Skriðuklaustur were born in Iceland, but some lived inland during childhood while some lived closer to the coast. Since Skriðuklaustur was a hospital, these individuals may have sought medical treatment at the monastery. The δ\(^{13}\)C and δ\(^{15}\)N values determined from bone collagen indicate that the people residing at Skriðuklaustur consumed a diet high in marine protein, while those residing at Skeljastaðir exhibit values more consistent with terrestrial resources.
Chronic gout in mature adult males from post medieval Chichester.

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We describe two cases of chronic gout in mature adult males (>46 years) from Chichester, England (18th – 19th century AD). Both individuals presented with poly-articular erosions in the feet and hands, particularly affecting the first metatarsophalangeal joints, the inter-tarsal and inter-carpal joints and the proximal interphalangeal joints. One individual was so severely affected that both of his first metatarsophalangeal joints had been completely destroyed and a number of joints in the hands had suffered subluxations. This individual also displayed erosions in a number of joints in the spine and may have been suffering from the early stages of diffuse idiopathic skeletal hyperostosis (DISH). A number of conditions can cause erosive lesions, including erosive osteoarthritis, rheumatoid arthritis and reactive arthritis. However, the appearance and location of the erosions in these two individuals suggests that they were caused by tophi, masses of uric acid crystals and inflammatory tissue, which form in cases of chronic gout.
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Vitamin D deficiency can be defined as a lack of a pro-hormone which causes a disruption in bone mineralisation, presenting itself as two conditions; rickets, a condition of bone growth and osteomalacia, a condition of bone turnover. This condition is primarily caused by insufficient exposure to UVB radiation, which at latitudes above 50°N of the equator could mean up to six months of the year with insufficient sunlight.

The late Anglo-Saxon population of Raunds Furnell, Northamptonshire, consists of 361 well preserved skeletons, of which 162 are non-adults. This small agricultural community situated in the Nene Valley sits at a latitude of 52.24°N. This population is currently being subject to reassessment for evidence of vitamin D deficiency on both the adults and non-adult individuals given the advancements made within the palaeopathological analysis of both conditions in recent years. A macroscopic analysis to identify any evidence of rickets, residual rickets and osteomalacia is currently underway. To date 150 individuals have been assessed and evidence of osteomalacia has been found.

The assessment of vitamin D deficiency in the archaeological record has proven difficult. It is well noted that an amalgamation of lesions is necessary for diagnoses and when one of the more prominent lesions, such as bowing of long bones, is absent diagnosis becomes more complicated. This research is attempting to identify if using a multi-method approach of recent advancements within the field aids in the diagnosis of vitamin D deficiency in the archaeological record.
Rehousing museum human remains collections: methods & practice.

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In spring 2019, the NHM completed a major project to refurbish the modern human remains collection. The previous collections furniture had been installed in 1976, and the space did not meet modern collections management standards – the compactor motors had failed, the floor was carpeted, and several important components on the Air Handling System had failed. Therefore, in 2015, the collections aspects of the refurbishment project began with a full, item based audit of the collection including the databasing and barcoding of human remains and other collection items to aid movement and future curation. By 2018, around 28,000 items had been barcoded, and moved to a temporary on-site store.

The modern human remains store is in an old WW2 communications bunker, which presented a number of unique challenges alongside those of undertaking development in historic buildings and in close proximity to museum collections. However, in early 2019, the refurbishment was completed and the collections moved back in. This poster will summarise the driving forces behind the refurbishment, the challenges involved in designing optimal storage for this type of collection, auditing and moving large collections, and the benefits that have arisen from the project.
That's all folks!