

# AN INTERIM REPORT ON THE HISTOLOGICAL ANALYSIS OF HUMAN BONES FROM FISHMONGER'S SWALLET, GLOUCESTERSHIRE

by

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## ABSTRACT

Fishmonger's Swallet, Alveston, Gloucestershire, has produced an unusual quantity of human and animal bone dating to the Late Iron Age. Iron Age burial evidence in the south-west of Britain is scarce and human remains in caves are rarely considered due to lack of secure dating evidence, so the material from this site offers rare insights into a poorly understood mortuary practice. However, the nature of deposition within the cave is unclear as the remains are disarticulated and heavily fragmented.

This paper presents an interim report on an ongoing histological study of bone diagenesis of human remains from Fishmonger's Swallet. The amount of bacterial bioerosion and fungal tunnelling in bone microstructure was assessed in seven human remains excavated from the cave in 2000-01 to examine early post-mortem treatments. The results of this analysis, considered alongside taphonomic observations by Cox and Loe (2022, this volume), indicates that the individuals were subject to a variety of post-mortem treatments prior to interment within the cave.

## INTRODUCTION AND BACKGROUND

Fishmonger's Swallet is a small swallet system in Alveston, Gloucestershire (ST 63313 87203) with a fascinating history. In 1994, local cavers led by the Hades Caving Club entered a 10 m deep chamber and discovered a substantial assemblage of commingled human and animal bone. Subsequent archaeological investigations by *Time Team* in August 2000 revealed the assemblage comprised mostly of canid (minimum 9 individuals) and human (minimum 6 individuals) remains with other animal bone representing horse, sheep, pig and cattle. Osteological examination of the human remains by Cox and Loe (2022, this volume) identified a number of elements with taphonomic evidence for violent death, manipulation and exposure among the disarticulated assemblage. One element, a distal right femur shaft, had a distinct fracture common in archaeological animal bones that have been exploited for marrow (Outram, 2001): this led to the long-held interpretation that the human remains within the cave represent victims of violent cannibalism, possibly as a stress response to the Roman invasion. The site was the subject of brief media attention after being excavated by *Time Team*, but interest dissipated and the results from the archaeological investigations remained unpublished.

A recent revival of interest in the site led to a programme of research focusing on the human and dog remains (Cox and Loe, 2022; Peto, *et al.* 2022 this volume). Among the new analyses was a series of radiocarbon dates from four human and three canid bone recovered from the cave in the earlier excavations that produced a tight range of Late Iron Age dates, with the human bone dating from 162 cal BC-cal AD 62 (Bricking, *et al.* 2022). The close range of dates suggests deposition within the cave occurred within a narrow timeframe and is unlikely to have been influenced by the Roman invasion. However, the disarticulation and commingling of human and animal bone caused by seasonal flooding makes it impossible to know whether the remains entered the cave as articulated (fleshed), partially articulated (partly decomposed or intentionally separated body parts) or disarticulated deposits. In the absence of burial context,

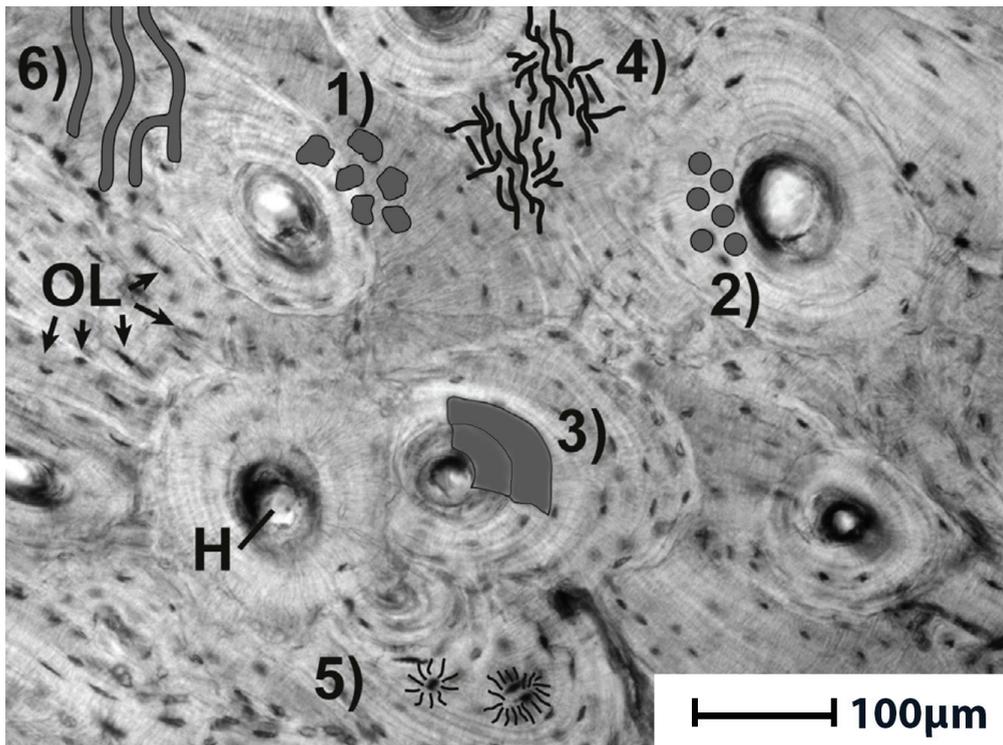
the combination of macroscopic and microscopic taphonomic analyses may aid interpretation of the nature of human remains deposition in the cave.

### *Aims*

This aim of this paper is to explore possible early post-mortem processes afforded to the human remains in Fishmonger's Swallet by employing histological analysis through thin section light microscopy, examining diagenetic changes to bone microstructure. This has the potential to elucidate early post-mortem treatment of human remains, including the possibility of cannibalism. This paper serves as an interim report and therefore does not discuss the wider implications of the results in great depth, but some interpretations of the taphonomic and microscopic evidence are offered.

### *Histotaphonomic analysis*

Background to the application of histotaphonomic analysis in archaeological bone samples has been described in detail in previous publications (Booth, 2014; Hollund, *et al.* 2012; Jans, *et al.* 2002, 2004; Smith, *et al.* 2007), so only a brief summary is offered here.



**Figure 1.** Schematic representation of microfocal destruction (MFD) seen in bone microstructure: 1) budded; 2) linear longitudinal; 3) lamellate; 4) Wedl type 1; 5) Wedl type 2 (enlarged canaliculi); 6) cyanobacterial tunneling. H=Haversian canal and OL=osteocyte lacunae  
Adapted from Brönnimann, *et al.* 2018, figure1.

Histological analysis involves the assessment of preservation and diagenetic change in bone microstructure. Micro-focal destruction (MFD) is the most common form of diagenesis seen in archaeological bone samples (Hackett, 1981; Turner-Walker, *et al.* 2002) and individual types of MFD can be identified by the type of tunnelling (Figure 1). MFD caused by bacteria is the most prolific, associated with budded, linear longitudinal and lamellate types (Hackett, 1981; Balzer, *et al.* 1997; Jackes, *et al.* 2001; Turner-Walker, *et al.* 2002). Other types of MFD are caused by microbes present in the depositional environment. Wedl tunnelling and enlarged canaliculi (Wedl type 2) are caused by fungi in wet environments (Fernández-Jalvo, *et al.* 2010; Hackett, 1981; Marchiafava, *et al.* 1974). Another type of MFD is caused by cyanobacteria which exist in aqueous environments (Bell and Elkerton, 2008; Huisman, *et al.* 2017; Jans, 2008; Turner-Walker, 2012; Villagran, *et al.* 2017). The presence of Wedl and cyanobacteria indicates that an affected element spent time in a wet, but aerated environment at some point in its post-mortem history.

The origin of the diagenetic bacteria that cause non-Wedl tunnelling is uncertain, but experimental studies have shown bacterial destruction of bone microstructure begins in the first few days after death and is mostly limited to the first ten years post-mortem (Bell, *et al.* 1996; Boaks, *et al.* 2014; Child, 1995a; Jans, *et al.* 2004; Nielsen-Marsh, *et al.* 2007; Trueman and Martill, 2002; White and Booth, 2014). Additionally, histological examination of bone from modern excarnated cadavers showed little to no bacterial attack (Bell, *et al.* 1996; Fernández-Jalvo, *et al.* 2010; White and Booth, 2014). This suggests that the bacterial MFD is likely the same endogenous gut bacteria that breaks down soft tissue during putrefaction (Bell, *et al.* 1996; Child, 1995b; Gill-King, 1997). Furthermore, the severity of bacterial MFD is understood to be independent of chronological age (Hedges, 2002; Hedges, *et al.* 1995; Jans, *et al.* 2004; Turner-Walker, 2012). Thus, histological analysis of archaeological human bone has been used as a proxy for reconstructing mortuary practice with increasing popularity, particularly with regards to mummification, exposure and non-normative pre-depositional treatment (Booth, 2020; Booth and Madgwick, 2016; Booth, *et al.* 2015; Booth, *et al.* 2022; Brönnimann, *et al.* 2018; Goren, *et al.* 2020; Hollund, *et al.* 2018; Jans, *et al.* 2004; Kontopoulos, *et al.* 2016; Machová, *et al.* 2020; Tjeldén, 2018).

The integration of histological analysis with macroscopic analysis of surface taphonomy maximises the interpretive potential of disarticulated remains where contextual information is absent. For example, histological examination of articulated inhumations typically shows extensive bacterial attack and poor histological preservation; conversely, butchered animal bone – which would have had minimal exposure to decomposition – shows good histological preservation with minimum bacterial attack (Booth, 2015; Booth, *et al.* 2022; Brönnimann, *et al.* 2018; Jans, *et al.* 2004; Nielsen-Marsh, *et al.* 2007; White and Booth, 2014). Following this, it stands to reason that if a disarticulated bone shows poor histological preservation, it is likely from a disturbed inhumation. If MFD is absent or minimal, it was likely removed from the body shortly after death, or was otherwise stripped of soft tissue rapidly (e.g. excarnation) or mummified (e.g. desiccated). This makes microscopic analysis of the human bone from Fishmonger's Swallet a valuable method for understanding the nature of deposition within the cave.

### *Summary of human remains*

A complete report on the osteological material from Fishmonger's Swallet is published in this volume. (Cox and Loe, 2022 this volume). A brief summary is offered here to give context to the investigation of mortuary practice in the present study. The disarticulated

remains from the cave account for a minimum of five adult individuals and include both sexes: of dimorphic elements, five male and six female specimens were recorded in the assemblage, but some of these may represent the same individuals. There are no subadults within the assemblage, which may be an intentional part of the mortuary practice, or they have been destroyed through natural diagenetic processes. Evidence for peri- and post-mortem modification was present on a fractured femur (see above, sample FSH01 in this study) with possible evidence for cut marks, percussion, abrasion, and defleshing on the surface. Gnawing (probably from canids) was present on at least 10 fragments indicating that the affected elements were available to animals at some point in their post-mortem history.

## MATERIALS AND METHODS

A total of seven human bone samples were analysed for histological preservation using thin section light microscopy. The sampled elements included two left femur shafts and two mandibles which were radiocarbon dated (Bricking, *et al.* 2022, this volume). Additionally, two small fragments of long bone and a fragment of cranium were selected from the heavily fragmented material to minimise damage to the assemblage. Cranial and long bone fragments were targeted to assess differences in treatment as special treatment of the head/skull has been widely cited in Iron Age contexts (see Armit 2012). Sample details are provided in Table 1.

The disarticulated nature of the assemblage and lack of stratigraphic evidence means it is impossible to determine discrete individuals from the heavily fragmented material. Therefore, it cannot be discounted that repeat sampling of the same individual occurred. Nevertheless, the sampled mandibles ensure that at least two different individuals are represented and given the complex taphonomy of the cave system, repeat sampling is considered relatively unlikely.

Specimen no.	Catalogue no.	Old catalogue no.	Element	Age	C14 date
FSH01	G10-1.1	-	Femur	Adult	154 cal BC-cal AD 26
FSH02	G10-1.2	A40	Femur	Adult	107 cal BC-cal AD 62
FSH03	G10-1.4	A320	Mandible	Mature adult	162 cal BC-cal AD 10
FSH04	G10-1.3	A402	Mandible	Mature adult	156 cal BC-cal AD 23
FSH07	-	-	Long bone	Adult	
FSH08	-	-	Long bone	Adult	
FSH10	-	-	Crania	Adult	

**Table 1.** Details of the elements sampled for histological analysis from Fishmonger's Swallet.

### *Sample preparation*

Transverse sections of compact bone (approximately 5 x 10 mm) were initially cut from the periosteum to medullary surface using a Dremel rotary saw with diamond wheel attachment. For long bones, samples were taken from the diaphysis. For the elements that had been radiocarbon dated, a small extension of the existing cut was taken for histological analysis (FSH01-04). When possible, samples were cut from posterior/lingual surfaces to minimise visual impact in the event of future display. The samples were then embedded in individual cylindrical moulds using a solution of epoxy resin (EpoFix resin mixed with EpoFix hardener, 25:3 ratio) following the protocol of embedding undecalcified bone (Schultz, 2001) to improve the structural integrity of the bone samples. The embedded samples were then placed in a Nucerite desiccator vacuum for at least 24 hours to harden. Transverse thin sections with a thickness of 65-70  $\mu\text{m}$  were created from the embedded samples using an annular diamond-saw microtome (REHA-tech RMS-16G). The thin sections were then mounted on glass slides (VWR 90) using a drop of Entellan New light refractive mounting medium, then covered with a glass cover slip and left for at least 24 hours to cure.

### *Analysis*

The thin sections were analysed using transmitted light binocular microscopes at 50x, 100x and 200x magnification. The microscope was fitted with a polarised lens to facilitate assessment of collagen birefringence. Digital micrographs of various microstructural features, including periosteal surface, central cortex, medullary surface and any other features of note, were captured using Nikon Eclipse ME600 and SPOT Software 5.1. Additionally, all thin sections were scanned under brightfield optics using a x4/0.10 Plan N objective lens of an Objective Imaging 'Surveyor' slide scanning microscope equipped with a QImaging QICAM Fast 1394 colour digital camera (Biomaging Hub, Cardiff School of Biosciences, Cardiff University). The combination of imaging techniques allows for a detailed rendering of the histological preservation and patterns of microbial attack.

### *Assessment of bioerosion*

The percentage of microstructure remaining for each sample was assessed using the Oxford Histological Index (OHI) (Table 2). OHI scores range from 0-5 with the lowest score representing complete destruction of microstructure, characteristic of an articulated inhumation; and the highest indicating perfect preservation similar to a fresh cadaver. The OHI scores provide a generalised overview of microstructural preservation and are augmented by qualitative descriptions of the character of degradation. This system has been shown to correlate well ( $r > 0.9$ ) with more rigorous quantitative methods of measuring backscattered electron images in SEM (Nielsen Marsh and Hedges, 2000: 1141). The samples were also analysed for collagen preservation (birefringence) and assigned a score of low, medium and high based on the intensity of birefringence when viewed with a cross-polarising lens.

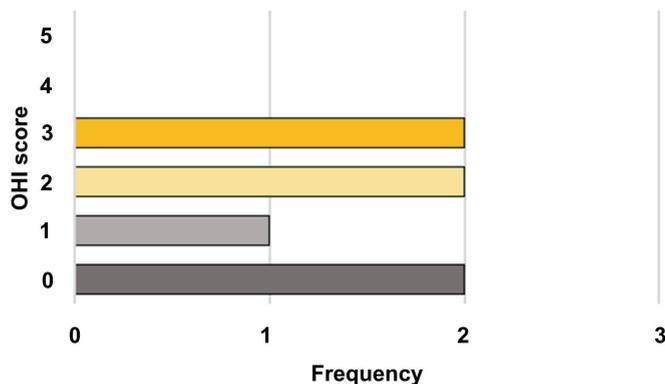
Specific microscopic focal destruction (MFD) were identified whenever possible based on the types identified by Hackett (1981): Wedl tunnelling types 1 and 2, linear longitudinal, budded, and lamellate (Figure 1). The distinction between Wedl and non-Wedl tunnelling is significant because the totality of bacterial (non-Wedl) attack can be used to imply early post-mortem treatments such as long-term inhumation, exposure, or a change of environment.

OHI score	% preserved bone microstructure	Description
0	<5%	No original microstructural features identifiable except Haversian canals
1	<15%	Small areas of well-preserved microstructure, or some lamellae preserved by pattern of destructive foci
2	<50%	Some well-preserved microstructure present between destroyed areas
3	>50%	Larger areas of well-preserved microstructure present among destroyed areas
4	>85%	Bone microstructure is fairly well-preserved with minor amounts of destroyed areas
5	>95%	Microstructure is very well preserved, similar to that of fresh/modern bone

**Table 2.** *The Oxford Histological Index (OHI) after Millard, 2001).*

## RESULTS

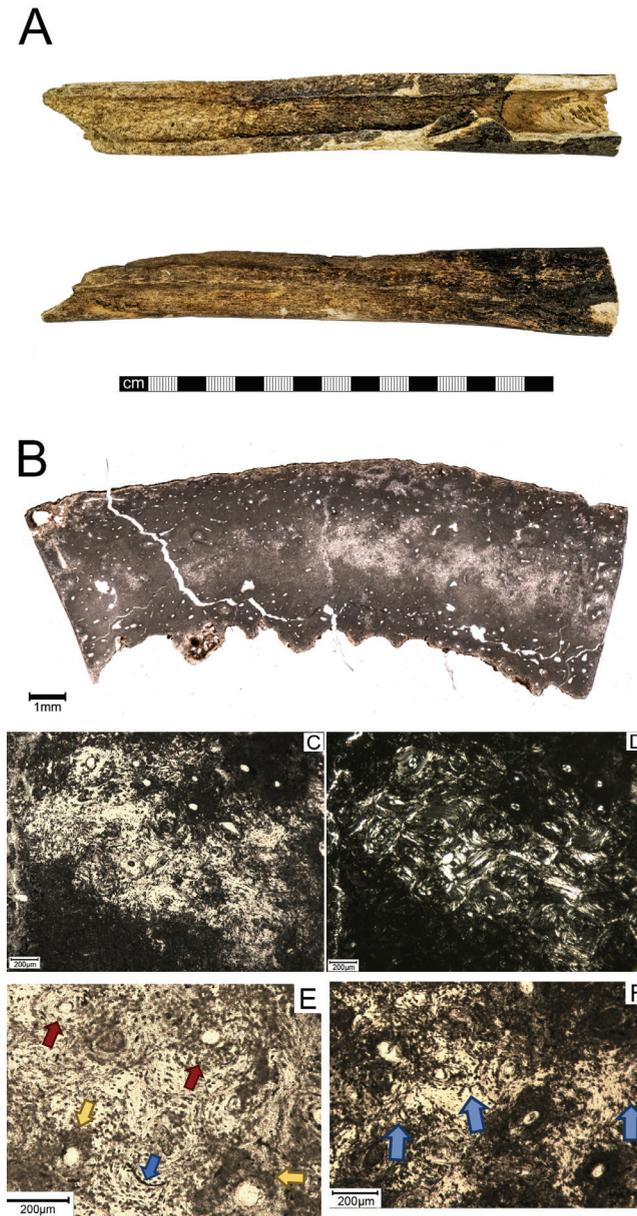
The OHI scores for each of the specimens are presented in Table 3 and Figure 2. Overall, the samples were extensively affected by fungal tunnelling consistent with Wedl types 1 and 2, likely from saprotrophic fungi present in the damp cave environment. However, the extent of microstructural preservation is variable with some samples showing complete or near complete destruction consistent with OHI 0 (n=2) and OHI 1 (n=1) and others showing an arrested pattern of attack consistent with OHI 2 (n=2) and OHI 3 (n=2). Since the sample size is small, the following sections will describe each specimen and examine taphonomic evidence alongside the histological preservation. Specimen numbers are used to identify specific samples to allow for inter-element comparison. This qualitative approach allows for a more nuanced evaluation of the evidence.



**Figure 2.** *Graph showing the distribution of OHI scores in human bone samples from Fishmonger's Swallet.*

<i>Specimen no.</i>	<i>Catalogue no.</i>	<i>Element</i>	<i>Taphonomy</i>	<i>C14 date</i>	<i>OHI</i>	<i>Birefringence</i>	<i>Comments</i>
FSH01	G10-1.1	Femur	Split fracture, cut marks, black staining	154 cal BC-cal AD 26	2	Medium	Area of preserved micro-structure in the centre; some Wedl tunnelling
FSH02	G10-1.2	Femur	Unknown depressions/scoops, extensive black staining	107 cal BC-cal AD 62	3	Medium	Areas of preserved micro-structure in the centre; extensive Wedl tunnelling
FSH03	G10-1.4	Mandible	Black staining (not extensive), concretions	162 cal BC-cal AD 10	3	High	Mixed preservation throughout; extensive Wedl tunnelling
FSH04	G10-1.3	Mandible	Black staining	156 cal BC-cal AD 23	1	Low	Heavily bioeroded with one preserved osteon; Wedl tunnelling
FSH07	-	Long bone			2	Low/medium	Small area of arrested bacterial attack surrounded by extensive bioerosion
FSH08	-	Long bone			0	None	No preserved microstructure
FSH10	-	Crania			0	None	No preserved microstructure

**Table 3.** Summary of sampled human remains from Fishmonger's Swallet.



**Figure 3.** *FSH01: A) The sampled element (femur shaft) showing a longitudinally split fracture and black staining. B) A scan of the thin section showing a margin of preserved microstructure in the centre. C) Micrograph (50x magnification) showing an area of well-preserved microstructure and arrested MFD attack. D) Polarised image of the same area showing high birefringence respecting the well-preserved microstructure. E) Micrograph (50x magnification) showing various microfocal attack: linear longitudinal (red), lamellate (yellow), Wedl type 1 (blue). F) Micrograph (50x magnification) showing Wedl type 2 tunnels (blue).*

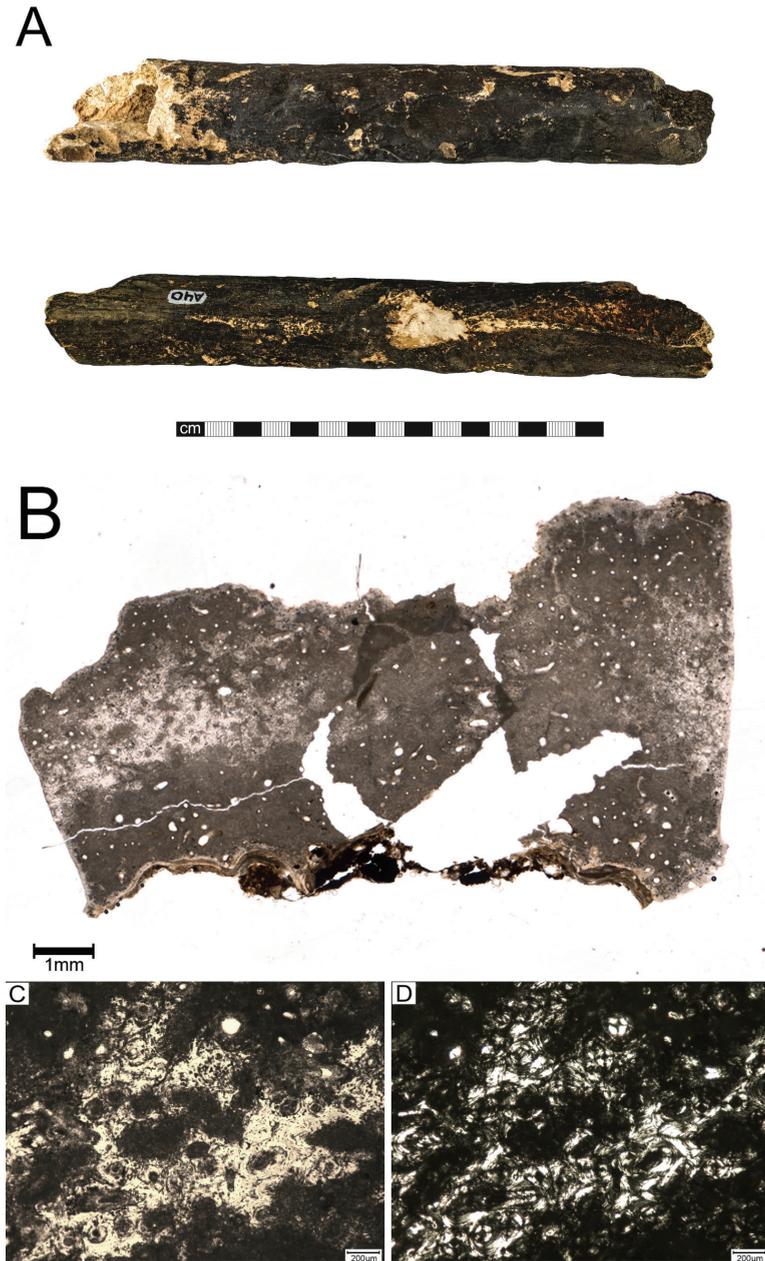
The femur with a longitudinal fracture mentioned above was sampled to assess the possibility of cannibalism (Figure 3A). In addition to the fracture, taphonomic evidence for manipulation includes cut marks and scraping possibly associated with defleshing. An element with evidence for peri- or early post-mortem processing might be expected to show good histological preservation as the taphonomy implies the element was removed from the body prior to decomposition, especially if it were intended for human consumption. However, the microstructure was extensively affected by microbial bioerosion with an area of well-preserved bone in the centre (Figure 3C, D). Bacterial attack and extensive Wedl tunnelling are shown throughout the sample where the attack is incomplete, resulting in an 'arrested' pattern of diagenesis (Figure 3E, F).

Another sample (FSH02) was taken from a robust left femur fragment with unusual taphonomy (Figure 4A). The bone surface is covered in irregular pits and shallow depressions, possibly percussion marks or scrapes, although the indentions could result from turbation in the cave environment. The chamber floods and drains quickly, causing a 'washing machine' effect, so it is plausible that the pitting could be caused by knocking into rocks and cavern walls. However, this type of taphonomic marking would be expected on many other bones from the excavated assemblage if that were the case. A more detailed examination of the lesions would be needed to determine the cause and whether they were likely anthropogenic or naturally occurring. The femur is fractured on both ends, but the fracture surfaces are unaffected by the black staining that covers the rest of the femur shaft, so it is likely that the fractures occurred during excavation.

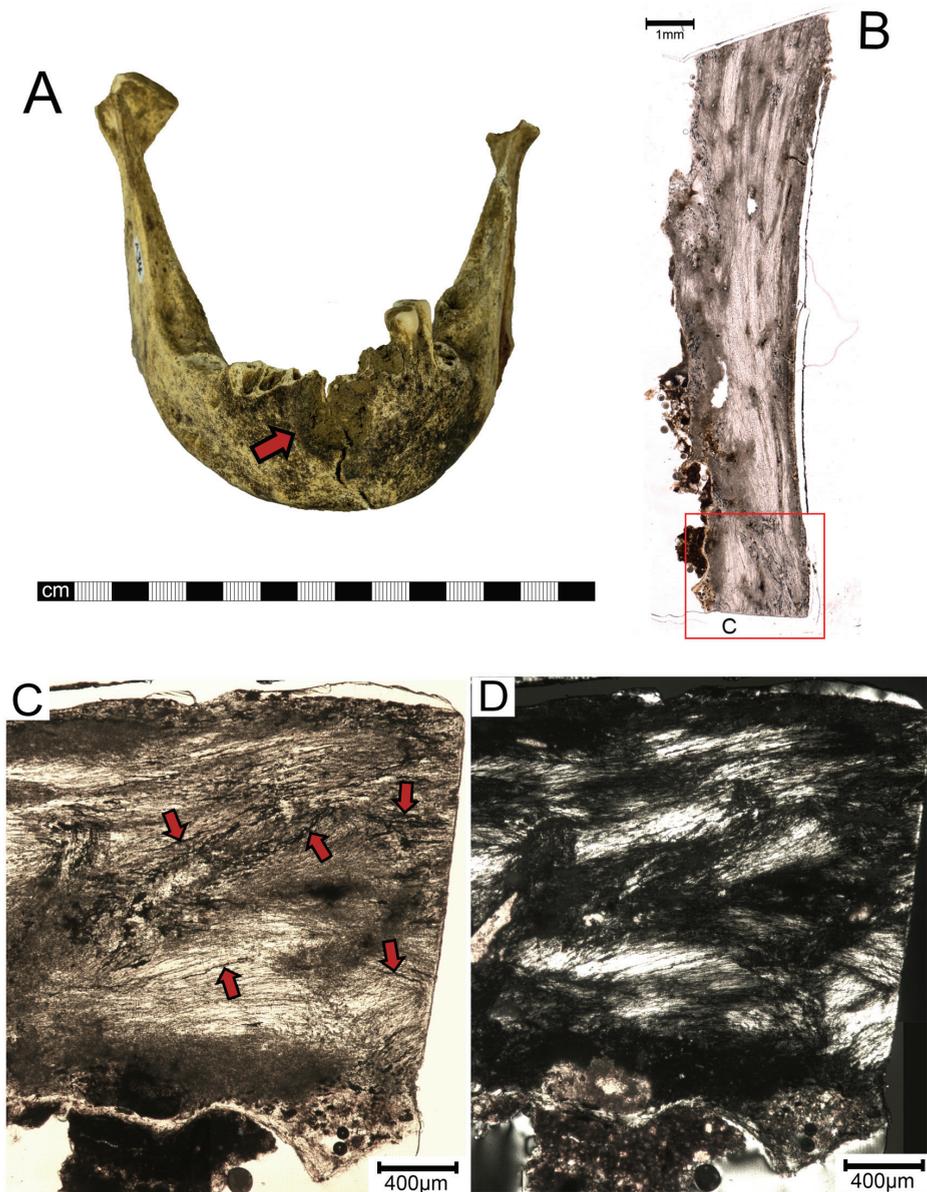
Similar to the split fractured femur (FSH01), the histological preservation of sample FSH02 shows a mixed pattern of bioerosion with well-preserved patches in the central cortex and the most extensive bacterial attack concentrated towards the periosteum and endosteum (Figure 4B). Wedl tunnels are seen throughout the sample and the bacterial attack appears to radiate from Haversian canals in an 'arrested' pattern, some completely enveloping the osteon and others stopping at varying levels of advancement (Figure 4C). The birefringence respects the areas of microstructural preservation (Figure 4D).

The specimen with the best preserved microstructure was FSH03, representing a mandible with a large abscess between the two central incisors (Figure 5A). The mandible is fractured at the abscess, likely due to post-depositional damage as the fracture surfaces appear to indicate a dry break. Like many other bones from Fishmonger's Swallet, much of the surface is stained black, but no other taphonomic indicators were noted.

Microfocal destruction is mostly concentrated toward the surfaces with the central microstructure remaining largely intact (Figure 5B, C), a pattern also reflected in the birefringence (Figure 4D). Most of the MFD appears to be caused by extensive Wedl tunnelling. It is worth noting that, in vertebrate carcasses, mandibles are typically among the first elements to disarticulate during decomposition (Hill, 1979; Hill and Behrensmeyer, 1985), so the earlier separation from the soft tissue may contribute to higher microstructural preservation in some instances, although experimental work is needed to confirm this.

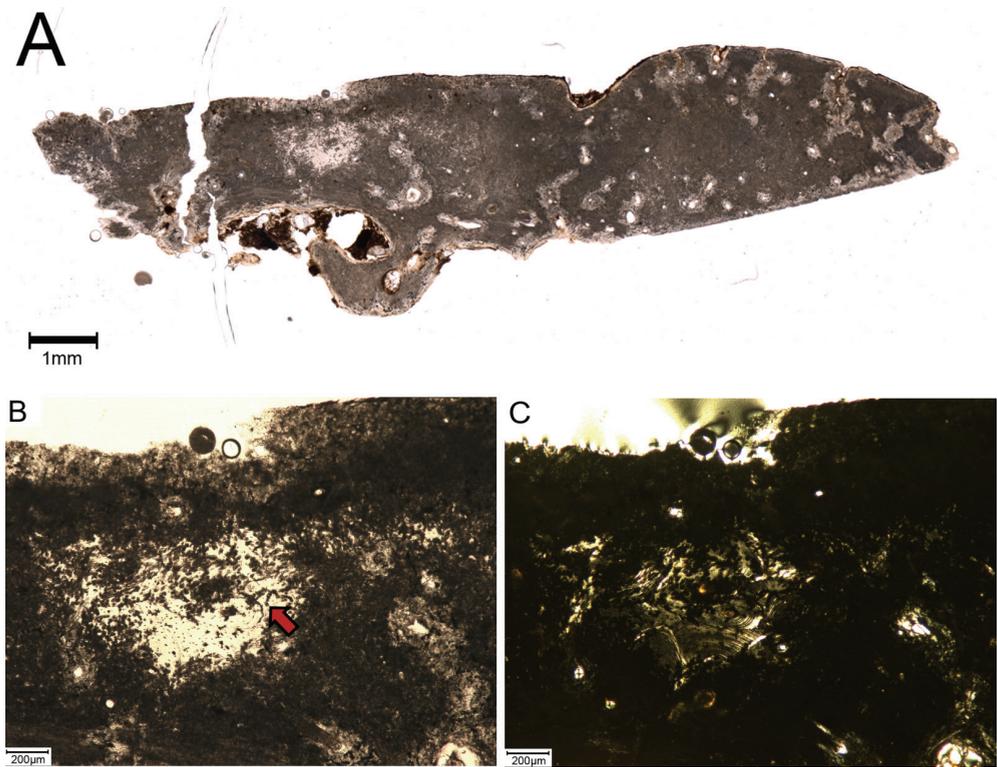


**Figure 4.** *FSH02: A) The sampled element (femur shaft) showing extensive black staining and irregular pitting on the anterior and posterior surfaces. B) Scan of slide A scan of the thin section showing margins of preserved microstructure in the centre. C) Micrograph (50x magnification) showing an area of well-preserved microstructure and arrested MFD attack. D) Polarised image of the same area showing high birefringence respecting the well-preserved microstructure.*

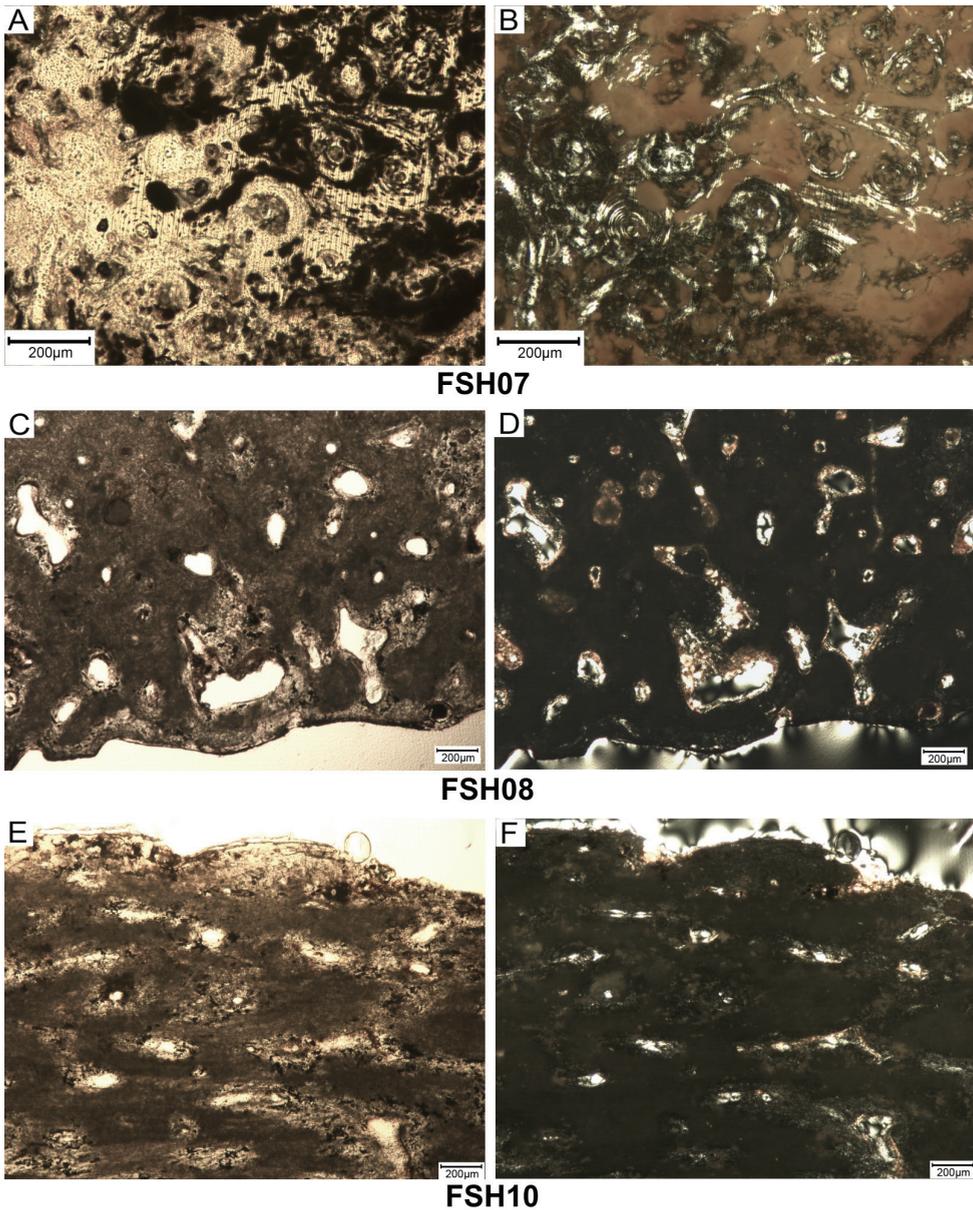


**Figure 5.** FSH03: *A) The sampled element (mandible) with the arrow pointing to a large abscess. B) A Scan of the thin section showing well-preserved microstructure across much of the sample with areas of MFD represented by darker patches throughout. C) Micrograph (50x magnification) showing a transverse section of the sample from the periosteal to endosteal surfaces with arrows pointing to Wedl tunnels. D) Polarised image of the same area showing high birefringence respecting the well-preserved microstructure.*

The other sampled mandible (FSH04) was more severely affected by bacterial bioerosion with only a small patch of preserved microstructure remaining, covering an area slightly larger than a single osteon (Figure 6A). The MFD is too densely concentrated throughout the sample to determine individual types, but Wedl type 2 tunnels are seen emerging from the osteocyte lacunae in the preserved osteon (Figure 6B). The sample has no birefringence except where the single osteon is preserved (Figure 6C). This mandible fragment (FSH04) was more extensively covered in black staining than the other (FSH03), possibly indicating a relationship between the severity of histological diagenesis and surface staining, although it is worth noting that FSH02 was more extensively stained than FSH01, yet had similar levels of microstructural preservation.



**Figure 6.** FSH04: A) A scan of the thin section showing a small area of preserved microstructure around a single osteon with the rest of the sample showing advanced levels of microfocal destruction. B) Micrograph (50x magnification) showing the small preserved area with an arrow pointing to Wedl-type 2 tunnels emerging from the osteocyte lacunae. C) Polarised image of the same area showing collagen birefringence limited to the small preserved area.



**Figure 7.** A) Micrograph of FSH07 (50x magnification) showing some areas of well- preserved microstructure and arrested bacterial attack. B) Polarized image of the same area showing collagen birefringence where the microstructure is preserved. C) Micrograph of FSH08 (50x magnification) showing the endosteal aspect with the highest levels of histological diagenesis and virtually no microstructure preserved. D) Polarised image of the same area showing no collagen birefringence. E) Micrograph of FSH10 (50x magnification) showing the periosteal surface with no preserved microstructure. F) Polarised image of the same area showing no collagen birefringence.

Sample FSH07 was taken from a long bone fragment too small to identify any macroscopic taphonomy apart from minimal black staining. The microstructure showed advanced levels of diagenesis with some dispersed areas of preserved bone in the central cortex (Figure 7A). In addition to Wedl tunnelling, budded MFD can be seen amongst the well-preserved microstructure suggesting arrested bacterial attack and the birefringence is low in these areas (Figure 7B).

The remaining two specimens, sampled from a long bone (FSH08) and cranial fragment (FSH10), showed the highest levels of bacterial bioerosion with virtually no original microstructural features remaining except Haversian canals (Figure 7C, E). The samples had no visible collagen birefringence, further substantiating the complete destruction of microstructure by osteolytic microorganisms (Figure 7D, F).

## DISCUSSION

Overall, the seven human bone samples from Fishmonger's Swallet display a range of histological diagenesis with OHI scores ranging from 0 to 3 (Figure 2). The absence of well-preserved samples may be attributed to fungal attack; the cave is wet, muddy, and prone to flooding. Moist environments such as this commonly yield bones afflicted by fungal tunneling. Wedl tunnels (types 1 and 2) have been shown to affect the samples with varying severity, so it is likely that fungal attack from the deposition environment is responsible for, or at least contributes to, much of the histological diagenesis seen in the samples. However, it is unclear why some samples would show variable preservation within the same depositional environment.

Although Wedl tunnels are clearly present across the sample, bacterial attack and variation of preservation would suggest that the human remains within the cave were subject to diverse pre-depositional mortuary practices. The specimens with OHI scores of 2 and 3 show an arrested pattern of bacterial attack, possibly representing a mortuary practice where decomposition was accelerated but did not occur as quickly as excarnation. A study on histological diagenesis of Iron Age human remains from storage pits at Danebury hillfort also produced diverse results, leading the authors to suggest protected exposure via covered pit to explain the samples with arrested bacterial attack (Booth and Madgwick, 2016). Alternatively, an interruption in advancement of bacterial attack within bone microstructure could be caused by removal of the element from a decomposing inhumation prior to skeletonisation. Disarticulated human remains from Carsington Pasture Cave, Derbyshire, were histologically analysed by Booth (2014: 363) and produced similarly varied results with a large proportion of the samples showing middle-ranging histological preservation, with one demonstrating cut marks consistent with dismemberment. It is possible that the samples with mid-ranging preservation from Fishmonger's Swallet underwent similar processes to those in Carsington Pasture Cave.

Other samples from Fishmonger's Swallet showed poor histological preservation consistent with long-term, primary inhumation. Since the cave is a dynamic environment prone to flooding, it is unlikely that these individuals were interred as articulated bodies within the cave because the corpses would likely disarticulate more rapidly than an inhumation placed directly in the ground, thus preventing bacteria from attaining the complete levels of bioerosion seen in FSH08 and FSH10. With this in mind, it is possible that the elements were selected and exhumed from already-skeletonised burials elsewhere and deposited within the cave at a later time as part of a mortuary practice. This is supported by the lack of smaller bones noted by Cox and Loe (2022 this volume).

Evidence for the intentional disturbance of burials and subsequent removal of elements in the Iron Age is known in southern Britain and likely accounts for the abundance of disarticulated elements found within settlements (e.g., Brittain, *et al.* 2014; Cunliffe, 1995; Cunliffe and Poole, 1991; Ellis and Powell, 2008; Sharples, 2010). The processes that occur between exhumation and redeposition of disarticulated bone remain ambiguous but can be inferred through taphonomic indicators of manipulation (old breaks, freshness of fractures, cut marks) and exposure (weathering, gnawing, trampling). Therefore, a possible scenario for the split fractured femur would be burial for a short time (evidenced by the arrested microbial attack), followed by exhumation and intentional breaking of the femur (evidenced by the type of fracture and possible cut marks), and finally deposition within the cave.

It is worth noting that there was no obvious difference observed in the microstructural preservation of cranial and post-cranial elements. A possible exception is FSH03, the sample with the most histological preservation with prolific Wedl tunnelling suggesting that much of the bioerosion was caused by osteolytic fungi. It is possible that this individual underwent different early post-mortem processes that caused more rapid decomposition, some process of bacteria-inhibiting preservation (e.g., desiccation) or was separated from the body through decapitation. However, there is presently no conclusive evidence for decapitation in the assemblage and the absence of vertebrae within the cave limits interpretation and further analysis incorporating more cranial and post-cranial samples would be needed to determine any meaningful difference in potential treatment.

#### *Is cannibalism in evidence?*

The results presented here do not support cannibalism of the individuals represented by the sampled elements. The histological preservation is not consistent with elements that had been removed from the body quickly after death, as would be expected if the person was consumed. Additionally, there was no taphonomic or histological evidence to suggest exposure to heat/burning/boiling and all reduction of collagen birefringence could be attributed to microbial bioerosion. Nor was there direct, unequivocal evidence for defleshing. However, microfocal destruction is so complete that it is impossible to disentangle bacterial from fungal attack. Therefore, it cannot be entirely ruled out.

Disarticulated long bones with similar longitudinally split fractures are known from other Iron Age sites in the south-west including the midden site at Potterne (Lawson, 2000) and Battlesbury Bowl (Ellis and Powell, 2008) in Wiltshire (see Bricking, forthcoming). The intentional breakage and deposition within various features in and out of settlements may indicate a wider mortuary practice where bones are transported elsewhere and broken (or vice versa) before their final deposition. Whether or not they were broken for the extraction of marrow, the act of disarticulation and intentional breakage fits within wider Iron Age mortuary practice in which bodies are often manipulated and redeposited (Madgwick, 2008, 2010).

#### *Future work*

This paper has presented interim results from histological analysis of human remains from Fishmonger's Swallet. Future work including histological analysis of targeted commingled animal bone recovered from the cave will improve the interpretations of the results presented in this paper. It was noted that canids were overrepresented in the animal bone assemblage (Peto, *et al.* 2022 this volume) and dogs are suggested to have been treated in similar ways to humans in Iron Age burials (Grant, 1989; Hill, 1995; Wait, 1985); therefore a

histological comparison of dogs and humans will provide more insight into the use of the cave as a mortuary monument.

The results presented in this paper form a case study within the author's PhD thesis investigating Iron Age mortuary practice in south-west Britain. Future work will include comparisons of histological and taphonomic evidence from contemporary disarticulated assemblages recovered from other site types in Iron Age Britain.

A series of analyses are planned for the assemblage including isotopic analyses to reconstruct diet and origins of the individuals represented in the cave. Additionally, an upcoming study using aDNA will provide a more nuanced understanding of the cave's use and the humans and animals deposited there including the sex of the individuals and familial relationships.

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