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Sex identification of a Late Iron Age sword and mirror cist burial from Hillside Farm, Bryher, Isles of Scilly, England

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ABSTRACT

A burial dating to the 1st century BCE was found in 1999 in the Isles of Scilly, south-west England. As well as being the most richly furnished burial in the region, it has grave goods considered to have oppositional gender associations: martial items (sword, shield) plus a bronze mirror. The inability to determine sex from the poorly surviving skeletal remains, using morphological or the available genomic methods at the time of its discovery, has been recognised as a key difficulty in the interpretation of this significant burial for Iron Age studies. Here, we apply high throughput DNA sequencing and analysis of dental enamel peptides to the highly degraded human remains in efforts to determine sex. The former effectively showed that no useable aDNA survived in the remains; the latter identified the sex as female with ca. 96% probability. This demonstrates the value of dental enamel peptide analysis for establishing the sex of ancient remains in circumstances where survival of skeletal remains is marginal and when diagenesis has effectively eliminated aDNA. Understanding symbolism in ancient burial rites, and hence making inferences concerning the social identities of the deceased is very difficult. These difficulties are not resolvable by biomolecular analyses. However, the sex identified from the proteomic work adds to the reconstruction of the biological identity of the interred individual, and helps to provide a firmer basis upon which debates concerning her social identity can be conducted. We discuss the funerary treatment of the interred individual in terms of her possible social *persona*, especially the meaning of the martial items for her potential role in Iron Age warfare.

1. Introduction

In 1999, a cist grave was uncovered at Hillside Farm, on Bryher, an island in the Scilly group, an archipelago approximately 45 km from Land's End, SW England (Fig. 1). The grave (Johns et al., 2002-3), which dated to ca. 100–50BC, was remarkable for the richness and type of metal objects it contained. In particular, it is unique in the western

European Iron Age for containing both a sword and a mirror, items conventionally thought to have oppositional gender associations. Swords are rather unusual finds in British Iron Age burials, especially in southern Britain. When they do occur in funerary contexts they are normally found with males (Jordan, 2016). Mirrors tend to be associated with female burials, albeit less convincingly (Joy, 2012). The importance of the Bryher burial means that it has figured prominently in Iron

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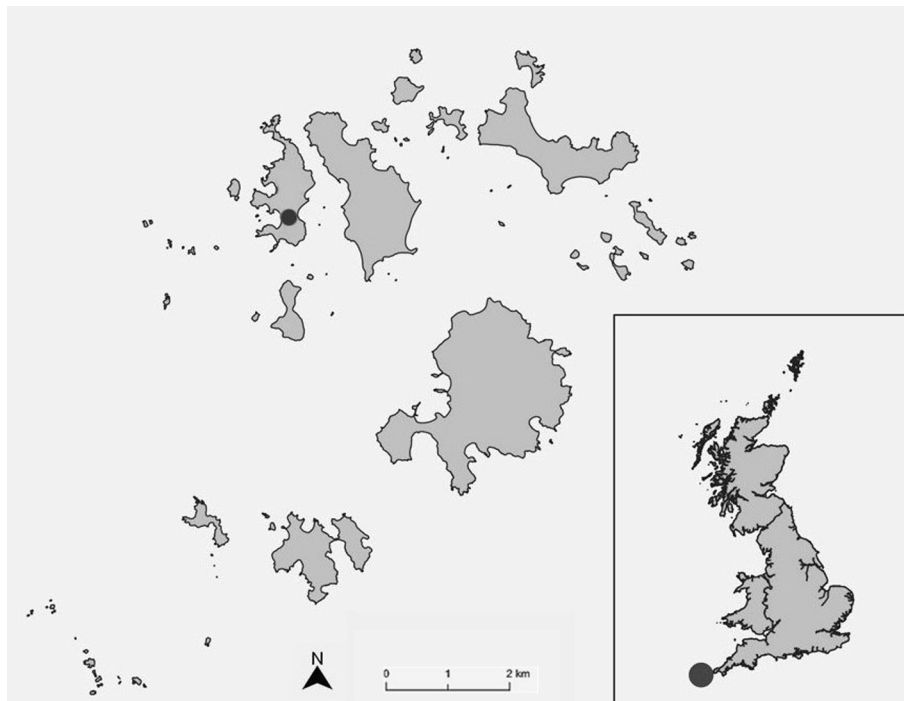


Fig. 1. Location of the Bryher burial.

Age studies. For example, it has featured specifically in discussions of funerary practice (e.g. Harding, 2016), gender (e.g. Jordan, 2016), and material culture (e.g. Joy, 2010), and well as in more general treatments of the archaeology of the period (e.g. Cunliffe, 2004: 79; 2005: 206, 557).

The granitic geology of Scilly meant that survival of skeletal remains in the Bryher burial was very poor. This precluded morphological sex determination (Johns et al., 2002-3: 20). At the time the remains were originally examined, sex identification using the then available DNA methods (targeted PCR amplification of sex-specific sequences of X and Y amelogenin gene alleles) was attempted. This failed to produce a result. This was thought to reflect poor DNA survival, a supposition consistent with the advanced bone diagenesis revealed by microscopy (Johns et al., 2002-3: 20–22).

In view of the apparently conflicting gender associations of the grave goods, the lack of a sex identification has been viewed as a major lacuna for our understanding of the Bryher burial (e.g. Joy, 2012; Moyer, 2012: 50-54; Harding 2016: 234). The purpose of the current report is to describe biomolecular work that has now enabled a firm sex determination to be assigned to the skeletal remains. We then re-appraise the burial in the light of this new information. However, we first briefly summarise the nature of the burial and place some of the original findings within the context of more recent studies.

2. The hillside farm burial

The excavation of the Hillside Farm interment, and descriptions of the finds associated with it, have been published in detail (Johns et al., 2002-3). For convenience, we briefly summarise matters here. The burial was located in a pit lined with stone slabs placed on edge, a style that typifies the archaeologically visible burial rite in Iron Age south-western England, including the Isles of Scilly. In the Isles of Scilly it is known as the Porthcressa-type. Porthcressa-type burials are characterised by approximately oval or rectangular grave pits. These are usually lined with stone slabs, coursed walling or a combination of both, with stone capping. Burial is by inhumation. Interments are generally flexed, placed upon the side. Copper alloy brooches, pottery and glass beads are

the most frequent accompaniments (Johns, 2019: 126–7). The Hillside Farm inhumation lay flexed on its right side. In addition to the mirror and the iron sword ca. 825 mm long which was in a copper alloy scabbard with suspension ring, grave goods included a copper alloy brooch and spiral ring, an unidentifiable shattered tin object, and remains of a hide-shaped (gently convex long sides with short, more sharply concave top and bottom) wooden and/or treated-hide shield



Fig. 2. The skeletal remains in the laboratory.

with copper alloy fittings. In addition, there was evidence for a sheepskin or fleece, together with a woven textile.

The skeletal remains (Fig. 2) comprised ca. 150 g of bone and dental enamel fragments. Most of the recovered bone fragments were severely eroded. Dental wear on the first and third permanent molar crowns suggests an age at death of ca. 20–25 years (Johns et al., 2002-3: 20; Mays et al., 2022: Fig. 4).

Bone stable isotope ratios obtained by the Oxford Radiocarbon Accelerator Unit as part of the radiometric dating programme were $\delta^{13}\text{C} = -19.0\text{‰}$ and $\delta^{15}\text{N} = +12.2\text{‰}$ (Johns et al., 2002-3: Table 2).¹ These are indicative of a mainly terrestrial diet, and are consistent with a primary dependence upon a mixed arable subsistence economy, as suggested by the archaeoenvironmental evidence from Bryher (Johns, 2019: 125–126).

No stable isotope data are available from other south-western cist grave burials. The closest coeval body of comparative data comes from Late Iron Age Dorset. This (N = 38 adults), gives mean values of $\delta^{13}\text{C} = -19.9\text{‰}$ and $\delta^{15}\text{N} = +9.4\text{‰}$ (Redfern et al., 2010: Table 3a). The Bryher burial is more enriched both in carbon-13 and nitrogen-15 than the Dorset group. The Bryher $\delta^{13}\text{C}$ matches the most elevated values among the Dorset burials and the $\delta^{15}\text{N}$ lies outside the range of the Dorset data. There are a number of interpretations of this, the most parsimonious of which is that the diet of the Hillside Farm individual, although mainly based on terrestrial foods, differed from that of most Dorset Late Iron Age people in also including a significant seafood element.

A sample of first molar dental enamel was analysed for strontium (Sr) isotope ratios and strontium concentration in an attempt to shed light on the geographic origin of the interred individual (Jordan, pers comm, 2021). This produced a $^{87}\text{Sr}/^{86}\text{Sr}$ of 0.709337 and a strontium concentration of 868 ppm. The strontium concentration in modern dental enamel varies between about 50 and 300 ppm (Montgomery et al., 2007). The elevated value is indicative of contamination from the burial environment and is consistent with the poor preservation of the enamel. Hence the isotope ratio would be of no value for indicating the *in vivo* geographic origin of this individual. This is reinforced by a strontium concentration of 1421 ppm from a bone fragment. Bone, being more porous than dental enamel, is more vulnerable to diagenesis, and the higher value reflects the elevated strontium levels likely in the burial environment. In the light of the strontium results, no attempt was made to analyse for enamel oxygen isotopes as originally planned (Jordan, pers comm 2021). Full details of analyses are presented in Jordan (forthcoming).

2.1. The Hillside Farm burial: Local and regional context

The south-western cist cemeteries are distributed from the Isles of Scilly through Cornwall to west Devon (Lamb, 2022: Fig. 10). A total of about 300 burials are known from the entire region, including about 36 from Scilly. The sites range from isolated burials to substantial cemeteries. It seems likely that inhumation was a rite selected for a small proportion of the population, the majority being disposed of in some way that has left no archaeological trace (Johns et al., 2002-3: 63; Cripps, 2007). Grave goods often accompany interments, (Whimster, 1981: 60–74), but they are not usually richly furnished, a metal brooch being a characteristic item (Todd, 1987: 179). None are as richly accompanied as the Hillside Farm inhumation.

Mirrors recovered from south-western cist graves are few. One was found at Trelan Bahow, on the Lizard Peninsula, Cornwall (Rogers, 1873), and parts of three were recovered from a cemetery at Stamford Hill, Plymouth (Bate, 1867). The circumstances of these finds are poorly documented, and the sex of the burials is unknown. Further afield, mirrors have been found in burials from Portesham (Fitzpatrick, 1996),

Bridport (Farrar, 1954), Langton Herring (Russell et al., 2019), and in two graves from Portland (Whimster, 1981: 258), all in Dorset. The Langton Herring, Bridport and Portesham individuals were female; the Portland burials were 19th century finds and the sexes are not known.

Turning to the martial items, the Hillside Farm interment is the only south-western cist interment with any weapons. The nearest weapon burial is a male from Whitcombe, Dorset, buried with a spear and sword (Aitken & Aitken, 1991). In addition, a fragmentary sword hilt, probably from a grave, was found at Bradford Peverill, also Dorset (Stead, 2006: 200). A scabbard fitting was found in occupation layers at St Mawgan-in-Pyder hillfort, Cornwall (Threipland, 1956; Stead, 2006: 177).

3. Biomolecular determination of sex

3.1. Methods

In view of the advances in biomolecular techniques since the original study of the remains was made more than 20 years ago, we apply two approaches to attempt to determine sex: genomic and proteomic. Sampling of the remains was undertaken with the agreement of the Isles of Scilly Museum. Handling and sampling of human remains was undertaken in accordance with current professional guidelines (Mays et al., 2013; BABA, 2017-2019).

3.1.1. Genomic methods

In a dedicated clean room at Harvard Medical School, we used a sterile dentistry drill to obtain powder from fragments of the neurocranium and an unidentified longbone diaphysis after surface cleaning and exposure to ultraviolet radiation to remove potential contamination from exogenous DNA. We used a procedure to extract DNA (Dabney et al. 2013; Rohland et al. 2018), and converted the extracted DNA fragments into four partially uracil-DNA glycosylase (UDG)-treated molecularly barcoded double-stranded libraries (two for the cranial fragment powder, and two for the long bone powder). The library preparation procedure involved adding adapters to the terminal ends of the extracted DNA fragments to allow them to be sequenced on Illumina instruments, and amplifying the molecules to allow sufficient material for enrichment and sequencing (Rohland et al. 2015). We enriched the libraries in solution using the "Twist Ancient DNA" reagent which targets about 1.43 million single nucleotide polymorphisms (Rohland et al. 2022). We sequenced the enriched products using Illumina HiSeqX10 instruments (v2.5 kit) for 2×100 cycles (2×7 cycles to read out the indices). We generated 14,841,045 and 21,049,053 read-pairs for the two libraries obtained from the cranial fragment powder, and 4,721 and 5,341 sequences for the two libraries obtained from the long bone powder (quality control measurements from the long bone libraries indicated inhibition of library preparation, explaining the low numbers of sequences). We trimmed adapters, merged reads-pairs that overlapped by at least 15 bases, and mapped the resulting sequences to the human reference genome (hg19) using the *bwa samse* command (BWA-v0.6.1) (Li and Durbin 2010). We removed sequences that we determined to be likely to be duplicates based on mapping to the same locations in the genome. We estimated the rate of characteristic damage in the final nucleotide based on the rate of thymine sequences at positions where the reference sequence is a cytosine, and adenine sequences at positions where the reference sequence is a guanine.

3.1.2. Proteomic methods

3.1.2.1. Sample preparation. The residual enamel sample was partially cleaned using a virgin double sided, diamond-coated steel disc (Brasseler Inc., Savannah, GA, HP medium, 18 mm diameter), or carbide steel burr (Brasseler Inc, Savannah, GA, US# 7 SH round). The enamel sample (20.4 mg) was demineralized by adding 200 μL of 1.2 M hydrochloric acid to 2 mL sample vial with seven 2.8 mM ceramic beads (Omni-

¹ The stable isotope data given for Bryher in Table 1 in Johns et al., 2002-3 are erroneous.

International Inc.). Samples were milled for three minutes at 6 m/s for 3 × 1 min mills with 1 min breaks on a BeadRuptor (Omni-Homogenizer Inc.). Vials were centrifuged for 1 min at 16300g and incubated at 56 °C for 1 h at 1200 rpm (Thermomixer, Eppendorf Inc.). The pH was adjusted to 7.5 to 8.0 with 2 M ammonium bicarbonate. Protease-Max (30 µg, Promega Inc.) and trypsin (1 µg, mass spectrometry grade,

Thermo Pierce Inc.) was added and incubated for 20–22 h, at 37 °C and 600 rpm. The incubation was centrifuged at 16,300 g for 5 min, and the resulting supernatant further filtered using a 0.22 µm PTFE (or PDVF) centrifugal filter (MilliporeSigma™). The resulting peptide mixture was concentrated using C18 ZipTips (MilliporeSigma™) and desalted into 50 µL 0.1% (v/v) TFA in 60% acetonitrile. Organic contaminants in

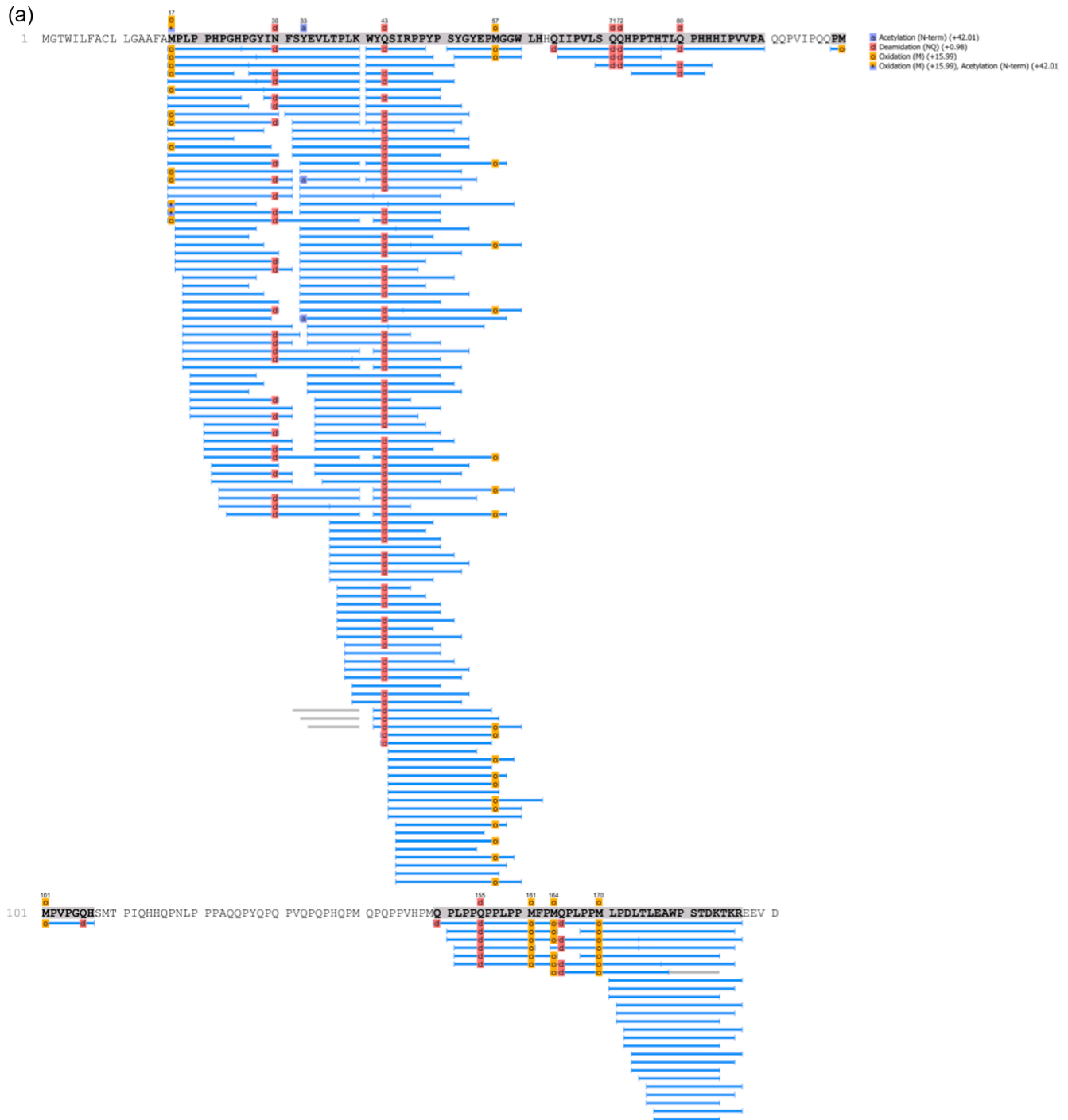


Fig. 3. (a) AMELX_HUMAN peptides detected in Hillside Farm enamel sample. Identified peptide sequences that corresponded to the X-chromosome amelogenin gene product (AMELX_HUMAN isoform-1) using PEAKs peptide spectra matching software are mapped as blue bars onto the sequence. Detected chemical modifications consistent with archaeological material, deamidation, methionine oxidation, are indicated as red or yellow squares respectively. Peptide sequences unique to the AMELX_HUMAN gene product are enclosed or partly enclosed by black squares. No sequences unique to the Y-chromosome amelogenin gene product (AMELY_HUMAN) were detected in the sample. (b) Proteome of the Hillside Farm sample. The signal of all peptides from detected proteins was summed for each gene product and normalised as a percentage against the total signal of all peptides (>1% FDR) in the sample. Detected proteins include amelogenin X (79.9% AMELX_HUMAN), ameloblastin (11.0% AMBL_HUMAN), enamelin (2.4% ENAM_HUMAN), type 1 collagen (0.01% COL1A1_HUMAN & COL1A2_HUMAN), and other proteins that derive from contaminating human squamous epithelial cells.

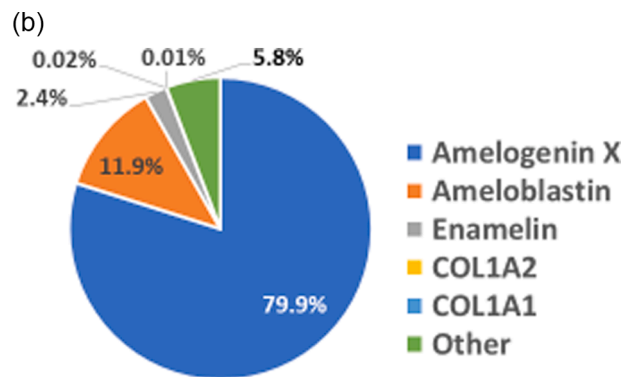


Fig. 3. (continued).

aqueous stocks and solutions were removed by prior passage over solid phase extraction (SepPak, C18, Waters Inc.). Reagent blank samples were prepared, and processed alongside each batch of samples. The Bryher Farm sample was the first applied to the instrument in the sample sequence.

3.1.2.2. Mass spectrometry. The peptide digest (30%) was analysed using an Exploris 480 orbitrap mass spectrometer (Thermo Inc.) using an in-line Dionex Ultimate 3 K UPLC over a 60 min-gradient. The resulting datasets in '.RAW' format were analyzed using PEAKS™ XPro (PEAKS Studio 10.6 build 20201221, Bioinform.com)(Zhang, et al., 2012) peptide spectra matching software, using a parent ion mass tolerance of 10 ppm, a fragmentation ion tolerance of 0.04 Da, unspecific cleavage, fixed carbamidomethylation, variable methionine oxidation, asparagine and glutamine deamidation, and N-terminal acetylation. Two missed cleavages and three chemical modifications were tolerated per peptide. A reference human proteome (UP000005640) with added amelogenin splice variants was used (Parker, et al., 2019). Resulting peptide spectra matches were filtered using 1% false discovery rate. Label free quantitation measurements of all sex-chromosome-specific peptides (ion current) were summed, normalized for enamel mass, and used to identify sex. AMELY_HUMAN peptides were considered an unambiguous indicator of male sex. In the absence of an AMELY_HUMAN specific peptide, female sex was calculated as a probability based on the logistic calibration curve developed using data from a Q-Exact Mass Spectrometry instrument (Thermo Inc.) where $Pr(F) = 1.0 + (0.059 - 1.0)/(1 + (x/7.54)^{13.99})$ and "x" is the logarithm (base 10) of the summed AMELX_HUMAN-specific signal (Summed Ion Intensity / mg enamel) (Parker, et al., 2019). Pr(F) results less than 0.5 are classified as indeterminate and rely on earlier data generated by the less sensitive Q-Exact instrument. The raw and processed datasets (.RAW and.csv formats) are available through the ProteomeXchange web portal (proteomecentral.proteomexchange.org) (Identifier PXD 043733).

3.2. Results

3.2.1. Genomics

The two ancient DNA libraries obtained from the cranial fragment powder yielded 282 and 156 unique sequences overlapping the targeted single nucleotide polymorphisms on chromosomes 1–22. The two ancient DNA libraries obtained from the long bone powder yielded 0 and 2 sequences. These numbers of sequences are all at or below the range expected from contamination levels in water samples (without addition of any bone powder), so there is no evidence of usable DNA preservation. For both the libraries obtained from the cranial fragment, the rate of characteristic ancient DNA damage in the final nucleotide is estimated at 1.8%, which is below the threshold of greater than 3% expected for authentic ancient DNA (Rohland et al. 2015), and indicative that the sequences we did have were largely reflecting contamination of modern

sequences.

3.2.2. Proteomics

Residual enamel (20.4 mg) from a canine tooth crown fragment was missing all associated dentin material, was blackened in appearance, friable and covered with a thin organic coating. After partial sample cleaning, processing and application to mass spectrometry, a total of 1159 peptides were detected that were matched to human sequences (less than 1% FDR), a total of 3.1×10^{10} ions. Consistent with the high degree of degradation, 79.9% of the signal originated from the X-chromosome form of amelogenin (Fig. 3). Remaining peptide signals originated from ameloblastin (11.9%, AMBL_HUMAN), enamel (2.4%, ENAM_HUMAN), collagens (0.04%, COL17A1; 0.02% COL1A2; 0.01% COL1A1) or miscellaneous proteins (5.8%) that were primarily skin keratin or keratin associated proteins, consistent with environmental contamination. Signal from peptides specific for all splice isoforms of X-chromosome form of amelogenin were detected at 5.5×10^9 , 3.7×10^8 , 3.1×10^5 ions respectively (94%, Q99217-1; 6%, Q99217-3 and, 0.01% Q99217-2). No peptides specific for the Y-Chromosome isoform of amelogenin (AMELY_HUMAN) were detected. Based off the logistic calibration curve for estimation of female sex the signal of AMELX_HUMAN was normalized to 2.1×10^9 ions per mg of enamel, with a Pr (F) value of 96%.

4. Discussion: a re-appraisal of the Hillside Farm burial

4.1. The possibility of a double burial

Double interments are occasionally observed in the south-western burial tradition (Whimster, 1981; Nowakowski, 1991). The apparently conflicting sex associations of the grave goods, coupled with the aggressive nature of the Bryher soils, raises the possibility that the Hillside Farm cist originally contained a further, putative male burial, from which identifiable remains failed to survive.

Among the few bone fragments that could be identified to element were pieces of the cranial vault. All that were present were consistent with a single individual in terms of their morphology. Among the dental enamel crowns, there was no duplication among those that could be identified. All tooth types were represented. The amount of dental wear was consistent with a single individual. Overall, the skeletal remains give no indication of a second individual in the grave; the evidence favours a single interment, but given the state of survival of the remains this assessment is not conclusive.

In double burials in south-western-type graves, the interments are usually placed side by side (Johns et al., 2002-3: 18–19). In the Hillside Farm cist there seems insufficient space for this. Only one brooch was found. It was positioned near the feet. Brooches are normally located at the upper body (e.g. Nowakowski, 1991) where they are thought to fasten a cloak around the corpse. If this was its function here, then the

garment would have to have been placed at the feet or perhaps laid inverted over the body. The latter was the case for a chain mail garment in a grave at Iron Age Kirkburn, Yorkshire (Stead, 1991), and was suggested from the placement of a brooch at an Iron Age grave in Deal, Kent (Parfitt, 1995). If it was a cloak-fastener, then a second brooch might have been expected had this been a double interment.

Given the lack of evidence for a second occupant, the remainder of the discussion assumes that the female, aged ca. 20–25 years at death, was the only individual placed in the cist at Hillside Farm.

4.2. *The symbolism of the grave inclusions and the social identity of the Bryher individual*

The purpose of a sword is to kill or maim (or to convey the threat thereof). A shield is carried when the individual in question expects to encounter similarly armed opponents. The function of mirrors in the Iron Age has long been debated (e.g. Joy, 2012). The Late Iron Age has been characterised as a period in which personal appearance began to assume increased importance in projecting social identity (Hill, 1997). Mirrors may have functioned as aids to personal adornment, and some have been found in association with items of cosmetic equipment (e.g. in the Langton Herring and Portesham graves – Fitzpatrick et al., 1996; Russell et al., 2019), perhaps supporting this interpretation in those instances. No items of cosmetic equipment were identified in the Bryher grave. The ability of mirrors to reflect images, transposing left and right and enabling users to see behind as well as in front, may have imbued them with shamanic or other ritual uses. Their reflective surfaces may have been viewed as thresholds between worlds. They may have been regarded as ritually powerful objects (Johns et al., 2002-3: 69–70; Giles, 2012: 186). As well as functioning to reflect an image, albeit one that is softened and somewhat indistinct (Fox & Pollard, 1973), a bronze mirror would also serve to reflect a beam of light, and may have had uses related to this. Heliographic signalling – communication via flashing beams of reflected light – is an effective way of signalling over distance in overcast as well as in sunny conditions (Hodge, 2001). This might have been of value for an island community for communicating with neighbouring islands and with craft at sea. The latter is an important consideration; the Isles of Scilly were in contact with the world beyond the archipelago throughout prehistory. Boats capable of intercontinental travel are known from the Bronze Age onward, and Scilly is at a strategic position on the approaches to western Britain (Robinson, 2007: 247–260). The existence of a decorative element on the reverse of the mirror resembling a sun-disc motif (Johns et al., 2002-3: 33) may suggest a heliographic function. No other British mirror bears a similar motif, nor has it been found on other Iron Age artifacts. However, similar designs appear frequently in prehistoric Europe (*ibid.*).

Given the female sex of the Bryher individual, the main focus of the discussion will be on the interpretation of the martial grave items – the sword and shield – but we will also reconsider the significance of the assemblage as a whole, particularly the other major item, the bronze mirror. In our discussion of the possible symbolic meaning of the martial items we consider first the simplest interpretation, that these were placed in the grave to symbolise that she took part in warfare, perhaps wielding these very weapons or ones much like them. We then move on to consider that they may have symbolised martial roles at a more abstract level, rather than meaning direct physical participation in killing. A third group of interpretations relate to the possibility that the grave goods may not primarily symbolise the roles held by the deceased but that their deposition in the grave fulfilled votive or social purposes that related primarily to the needs of the living community.

Ethnographic evidence indicates that warfare is pervasive in small-scale societies (e.g. Keeley, 1996; Gat, 2006). In recent decades there has been a realisation that archaeology has under-recognised this fact, and hence has marginalised the role of collective violence in prehistory and presented too pacified a vision of the past (Parker Pearson, 2005; Allen & Arkush, 2006; Armit et al., 2006; Knüsel & Smith, 2013; Ralph,

2013; Roymans & Fernández-Götz, 2017; Dolfini et al., 2018). War involving state-level societies characteristically consists of formal battle between opposing armies. Although encounters of this type may form a component of warfare in non-state social formations, the predominant form of inter-community warfare is raiding. Here, a war-party stages a surprise attack upon an enemy settlement. Such an attack involves killing people they encounter, together with destruction and looting. Ethnographic studies indicate that such raids serve a variety of purposes (Keeley, 1996; Gat, 1999; Glowacki & Wrangham, 2013; Macfarlan et al., 2018). They are effective at depleting an enemy and they may enable food or material goods to be acquired. Significant though these material benefits may be for the aggressors, it is often the social functions of raiding that are more important (Glowacki & Wrangham, 2013). They may be a means of exacting retribution for perceived wrongs and may be part of cycles of vengeance and vendetta; they may enable prestige to be acquired and social relationships to be strengthened among those forming a raiding party. Captives are not usually taken; normally raiding parties kill men, women and children indiscriminately (Keeley, 1996). On the occasions when captives are taken, they generally comprise women or children; one purpose for the taking of captives is enslavement (e.g. Gat 1999). The element of pre-planning and surprise enables the purposes of a raid to be realised whilst minimising the risk of death or injury to the aggressors (Keeley, 1996; Gat, 1999; Macfarlan et al., 2018). Collective violence between small-scale societies should not be viewed as an aberrant condition but, because of the important social functions it fulfils, it forms an integral part of social dynamics (Halbmeyer, 2001; James, 2013).

Warfare, and the threat of it, was therefore likely to have been an important part of prehistoric peoples' lives. Raiding was likely the dominant form of warfare in European prehistory (Bishop & Knüsel, 2005). There is some evidence for it in the Iron Age of southern Britain from human skeletal remains showing perimortem trauma. Analysis of remains from Late Iron Age horizons at Maiden Castle hillfort, Dorset (Redfern, 2011; for further discussion see also Redfern & Chamberlain 2011; Redfern & Hamlin, 2022), show that both sexes were exposed to violent injury, consistent with the idea that assailants attacked both men and women. In discussing raiding in Iron Age southern Britain, Redfern (2020) notes that in the Late Iron Age especially, taking of captives for enslavement may have been an important motivation. The Roman Empire was economically dependent upon the institution of slavery and Britain was noted as an important exporter of slaves. At Danebury hillfort, Bishop & Knüsel (2005) offer a reinterpretation of the human remains in which they argue the mortality profile suggests that men and children were killed while the attackers may have deliberately spared the women. A similar pattern was seen at Kemerton Camp hillfort, Worcestershire (Western & Hurst, 2013). Although a definitive explanation for these findings is elusive, they would appear consistent with Redfern's suggestion of raiding with a purpose of taking female captives for enslavement.

In the Isles of Scilly and mainland south-west England, soil conditions mean that skeletal evidence for violent injury is not preserved. In the region as a whole, there are defended settlement sites, both hillforts and also 'cliff castles' – promontories with ramparts defending the landward side. The Isles of Scilly themselves lack proven hillforts, but there are cliff castles. Cliff castles are often considered to be the coastal equivalent of hillforts (e.g. Cunliffe, 2005: 205; Cripps, 2007). As with the hillforts, their functions have been subject to much debate. Some have suggested functions as trading centres (e.g. Herring, 1994). Others have emphasised that their spectacular and liminal location between land and sea might have rendered them suitable for religious / ceremonial purposes (e.g. Cripps, 2007; Giles & Cripps, 2012). They may also have been used for other communal activities, or as visible claims to land or other resources (Nowakowski & Quinnell, 2011). There are at least three cliff castles on Scilly (including one on Bryher itself), perhaps corresponding to territorial divisions on the islands (Johns, 2019: 122–3). Whilst we agree with a recent reconsideration (Nowakowski &

Quinnell, 2011) that single-purpose explanations of cliff castles are unhelpful, the defensive ramparts, and hence the potential of these sites as an adaptation to a threat of raiding, cannot be overlooked. Bryher would have been at risk from seaborne raids not only from nearby communities but also from further afield. Scilly's location on seaways between continental Europe and western parts of the British Isles would have made them tempting targets for maritime raiders. The particular vulnerability of small island communities to seaborne raiders is obvious.

Although the soil conditions mean that we cannot confirm violent interactions using skeletal remains, the position taken in the remainder of this paper is that warfare was an integral part of social dynamics on Iron Age Scilly. This is based upon the ubiquity of raiding-type warfare in pre-state societies, the growing consensus regarding the importance of inter-group violence in prehistory, and the growing evidence for this in Iron Age Britain.

For a community to survive in conditions of chronic insecurity and the ever-present threat of violent attack, they must depend upon their own physical capacities to deter and combat aggressors (James, 2018). In a small, island community, it would clearly be advantageous if all able-bodied individuals could contribute to the defence of their settlement by force of arms should it come under attack. Under such circumstances, the ability to accomplish martial deeds may have been valued in both sexes. Discussing Bronze Age Anatolia, another early society thought to be characterised by endemic raiding, Selover (2020) notes the regular presence of weapons in female graves. She argues that women were defending themselves using weapons during attacks on settlements. Similar arguments might apply for Bryher, but should we assume that the Hillside Farm woman played a purely defensive role? Some lines of evidence might support that. From research in psychology, it has been argued that women are generally more willing to participate in collective acts of violence if they are for defensive rather than offensive purposes (Lopez, 2017). Males are more naturally aggressive (Gat, 2006; McDonald et al., 2012). In small-scale societies, there is usually less benefit to women than to men in joining raiding expeditions (Adams, 1983; Glowacki & Wrangham, 2013). Ethnographic evidence shows that it is highly unusual for women to form part of raiding parties (e.g. Adams, 1983; Macfarlan et al., 2018), although it has occasionally been recorded (e.g. Ewers, 1994). In a small island community such as Bryher, women in general might be expected to have participated in its defence when under attack. It would therefore be hard to explain why the Hillside Farm woman was singled out for such unusual treatment in burial if this was her only role, especially if raiding attacks on communities were commonplace at the time. This becomes more readily understandable if she had a prominent role in undertaking raids on other communities or a leadership role in organising raids, as well as participating defensively.

The potential heliographic function of the mirror might be consistent with a leadership role relating to warfare, perhaps in planning and / or coordinating raids on other communities as well as in defence against attackers. Ethnographic evidence shows that rituals almost always take place before and after raids are conducted: for example, to enlist supernatural support, to let the dead of previous conflicts know they will be avenged, and afterwards to purify returning warriors (Gat, 2006: 127). The possible ritual functions suggested for mirrors in the Iron Age may indicate this sort of role for the Hillside Farm woman. This advances the possibility that the martial items symbolise not her direct physical involvement in warfare, but some lead role in these other aspects associated with it. Their deposition in her grave may also have meant that she was intended to continue to play a martial or protective role after her death, acting as a supernatural guardian for her community.

We now turn to some of the potential weaknesses in these interpretations. In some contexts, for example Viking Age Scandinavia, the early Iron Age of southern Russia and the Ukraine, and Bronze Age Anatolia, males are regularly interred with weapons, and these are usually interpreted as symbolising the martial roles of these individuals. When women in these cemeteries are similarly interred, the

interpretation that they too engaged in martial activities seems logical (Hedenstierna-Jonson et al., 2017; Price et al., 2019; Guliaev, 2003; Selova, 2020). By contrast, the uniqueness of the martial items in the Bryher grave shows it was clearly not usual to recognise those who undertook martial deeds in life by placing weapons in their graves in the Late Iron Age of south-west England. This would appear to weaken our 'warrior burial' interpretations.

Given that the meaning of grave goods may only be indirectly related to their functions outside funerary contexts, an alternative is that the presence of the martial equipment may have symbolised affiliation to a certain social group rather than signifying warrior status. Perhaps the martial equipment in the Bryher grave signified affiliation to groups elsewhere where interment with such items was a more regular part of funerary tradition. In Britain, this would mean East Yorkshire. Interments from that region dominate the corpus of martial inhumation burials in Iron Age Britain (Inall, 2016). However, the Bryher sword differs in type from those customarily found there (Stead, 2006), and hide-shaped shields appear particular to southern Britain (Inall, 2020), making such a connection less likely. One might argue that the martial items symbolise links with other groups that more sporadically inter with martial items (including similar types to those deposited at Hillside Farm), perhaps as an indicator of elite status. The Durotrigians in the Dorset region or, further afield, the Cantii in the Kent area are examples of groups that could plausibly have had seaborne links with Scilly. In both these cases, richly furnished (male) 'warrior' burials have occasionally been found (Aitken & Aitken, 1991; Parfitt, 1995). But these are rare, and explanations invoking the symbolising of links with distant elites fail to explain why the Bryher woman was interred with characteristically male associated items, and the lack of isotopic or genomic data frustrates the testing of hypotheses of genetic or geographic links.

Furnishings may have been placed in the grave for other reasons that had little to do with the social *persona* of the deceased. Items may represent offerings to supernatural agencies in response to event(s) connected with the death of the person that appeared to threaten or otherwise impacted the community (Harding, 2016: 170). There may be a commonality of role here with objects deposited in watery places; although it is possible that these may represent items deposited along with corpses as part of mortuary practice, they are more often interpreted as votive deposits (Wait, 1985: 17-19). In the Iron Age of southern Britain, the great majority of swords come from rivers not graves (Garrow & Gosden, 2012: 115-134). Mirrors and shields too are occasionally found from watery contexts (Cunliffe, 2005: 566-570; Giles & Joy, 2007). Donation of spectacular items at funerals may be a means of self-aggrandisement for mourners (Leach, 1979). Those attending the funeral may also present important items as tokens in order to express allegiance to the kin group or community of the deceased (Giles, 2012: 126; Harding 2016: 170).

The mirror in the Hillside Farm burial shows evidence that it was old when it was deposited. It is unclear whether this was also true of the sword and shield (although both were broken when found). It seems possible that the diverse grave items were heirlooms passed down from more than one 'owner'. Perhaps the Bryher woman died before producing an heir, so that in the absence of appropriate recipient(s), the items were buried with her. Comparison with historic data (Lehmann & Scheffler, 2016) suggests that average age at first menses in pre-modern times may have been in the late teens. This is normally followed by up to three years adolescent sterility (Bogin, 1999), so with death for the Bryher woman in her early 20s, dying childless is quite likely. A similar explanation was advanced for the Late Iron Age burial, briefly referred to above, at Langton Herring, Dorset. This too was a young adult (ca. 19-24yrs old) female buried with an eclectic variety of grave goods (Russell et al., 2019).

5. Conclusions

Items may be placed in a grave for a variety of reasons that are now

lost to archaeologists. Although there are plausible interpretations of the Hillside Farm burial based upon possibilities that the grave goods had little to do with the social roles of the interred woman, we favour interpretations based on the assumption that they do, however indirectly, symbolise aspects of her social *persona*. This is consistent with ethnographic evidence that consistently, but by no means invariably connects funerary treatment with social identities of the deceased (e.g. Binford, 1971; Tainter, 1978; Carr, 1995). Connecting the martial grave goods with a martial role in life would also be consistent with emerging evidence of female roles in violent interactions in Iron Age societies. Historic sources on female warrior leaders such as Boudicca (first century AD) are, of course, well known, female engagement in violence in Celtic mythology is frequent, and depictions on coinage in Continental Europe show that females were not excluded from martial ideologies (Redfern, 2006; Pope & Ralston, 2012). Such sources are problematic for inferring regular female participation in conflict, but study of skeletal remains from the British Iron Age is beginning to provide evidence of female participation, probably as combatants (Redfern, 2006). Although we are mindful of the difficulties (for example, the lack of direct skeletal evidence for violence on Iron Age Scilly due to the non-survival of bone), given this background, our interpretation of the Bryher woman as actively involved in warfare seems reasonable. Given the probable nature of social organisation in Late Iron Age south-west England (Cripps, 2007), this most likely meant a prominent role in raiding. Whether the martial items symbolised physical participation and/or participation at a ritual/organisational level, is unclear, but the potential heliographic or ritualistic functions of the mirror may suggest that the grave symbolism includes references to the latter.

The results from Hillside Farm demonstrate the value of enamel peptides in sex determination when soil conditions are hostile to skeletal remains. Soils weathered from granite, such as those in Scilly, are not only inimical to bone preservation, but at Bryher were also associated with destruction of DNA in the bone fragments that did survive. This precluded sex identification not only on morphological grounds but also genetically. Such soil conditions are common across south-western parts of England, and elsewhere. In such instances, dental enamel may be the only skeletal tissue to survive (e.g. McKinley, 1994: 136; Johns & Taylor, 2016). However, provided that care is taken to recover dental remains via sieving of the grave soil (e.g. Mays et al., 2012), key aspects of biological identity such as age at death (via dental wear) and sex, via proteomics, may be obtained.

The burial at Hillside Farm emphasises the value of biomolecular sex determination when this is not possible from skeletal morphology. Understanding symbolism in ancient burial rites, and hence making inferences concerning the social identity of the deceased, is fraught with difficulties. These difficulties will not be resolved by biomolecular analyses. Understanding funerary ritual and inferring social identities will continue to depend upon traditional methods, including the appropriate use of ethnographic analogy and close attention to archaeological context. However, biomolecular studies that permit firm identification of sex, or else provide evidence regarding other aspects of biological identity, will potentially provide a firmer base upon which debates concerning the social identities of the deceased can be conducted.

CRedit authorship contribution statement

S. Mays: Conceptualization, Investigation, Writing – original draft, Writing – review & editing, Project administration, Funding acquisition. **G. Parker:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – review & editing. **C. Johns:** Resources, Writing – review & editing. **S. Stark:** Visualization, Writing – review & editing. **A.J. Young:** Investigation. **D. Reich:** Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – review & editing. **J. Buikstra:** Writing – review & editing. **K. Sawyer:** Writing – review & editing. **K. Hale:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Proteomic data will be uploaded to proteomexchange webportal prior to publication of article

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