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ARTICLE

Roman cremations of Via XVII, *Bracara Augusta* (preliminary analysis). Part II: Post-cremation Taphonomy and Preservation

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ABSTRACT

Taphonomic factors in bioarchaeology are pertinent and of diverse origin. Funerary gestures are taphonomically relevant in all funerary contexts. The Via XVII (*Bracara Augusta*; 1st b.c.e. to 3rd c.) Roman necropolis nucleus cremations are represented by depositions of diverse type and conservation with potentially differential taphonomic alterations. The aims are to (1) analyze identifiable cremains preservation and fragmentation and (2) interpret them according to deposition traits.

Eight cremation depositions (seven secondary burials and one *ustrinum*) from Via XVII were studied. The Anatomic Preservation Index (API) was scored, and the measurement of the largest fragment and the weights of cremains of different calibers (>2 mm, >4 mm and >10 mm) were used to analyze fragmentation. API was correlated to the other enumerated variables (Kendall's τ-b coefficient).

Generally, preservation was low and fragmentation was high, especially in secondary depositions with unurned cremains or a fragmented urn. Preservation was correlated to the proportion of large fragments ($\tau = 0.571$; $p = 0.048$) and hindered by likely partial recovery from the pyre. The *ustrinum* (primary deposition) presents average fragmentation, which suggests cremains redeposition observed in the other contexts promoted fragmentation.

Preservation and fragmentation can illustrate the impact of funerary gestures on taphonomy, as suggested by these preliminary results. Further research of the full depositions from Via XVII (137 cremation burials and 107 *ustrina*) is essential.

Keywords: Archaeology; Biological Anthropology; cremains; bone decomposition; diagenesis; Imperial Hispania.

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RESUMO

Os fatores tafonómicos são pertinentes em bioarqueologia e têm origens diversas. Os gestos funerários são tafonomicamente relevantes em todos os contextos funerários. As cremações do núcleo da necrópole Romana da Via XVII (*Bracara Augusta*; finais do séc. I a.n.e. a III) são representadas por deposições de tipo e conservação diversificados, com alterações tafonómicas potencialmente diferenciadas. Os objetivos são (1) analisar a preservação de fragmentos identificáveis e a fragmentação de ossos cremados e (2) interpretá-las de acordo com as características de deposição.

Oito deposições de cremação (sete enterramentos secundários e um *ustrinum*) da Via XVII foram estudados. O Índice de Preservação Anatómica (API) foi registado; a medida do maior fragmento e o peso de fragmentos de diversos calibres (>2 mm, >4 mm e >10 mm) foram usados para analisar a fragmentação. O API foi correlacionado com as restantes variáveis enumeradas anteriormente (coeficiente τ-b de Kendall).

Na generalidade, a preservação era baixa e a fragmentação era elevada, sobretudo em deposições secundárias sem urna ou com urna fragmentada. A preservação correlacionou-se com a proporção de fragmentos de maior tamanho ($\tau = 0.571$; $p = 0.048$) e foi mais elevada nas deposições com peso coerente com a recolha dum esqueleto completo da pira. O *ustrinum* apresentou fragmentação média, sugerindo que a redeposição de ossos cremados observada nos outros contextos promoveu a fragmentação.

A preservação e a fragmentação podem ilustrar o impacto tafonómico dos gestos funerários, como sugerido nestes resultados preliminares. A futura investigação da totalidade das deposições da Via XVII (137 enterramentos de cremação e 107 *ustrina*) é essencial.

Palavras-chave: Arqueologia; Antropologia Biológica; ossos cremados; decomposição óssea; diagénese; Hispania Imperial.

Introduction

Many diverse factors have an influence on bone preservation and taphonomy. Taphonomic alterations are liable to occur at any time from the individual's death to its remains' integration (from the biosphere) into the lithosphere (Stodder, 2008; Lyman, 2010). Treatment of the individual before deposition is therefore very important; cremation, in particular, aids bone preservation in harsh taphonomic conditions – especially acidic soils - despite promoting its fragmentation (Mays, 1998). The type, depth and the inclusion of grave goods are other deposition choices affecting post-depositional taphonomic alterations (Jans et al., 2004; Pokines and Baker, 2014). Diagenesis, namely the alterations on bone after deposition, is affected by intrinsic and extrinsic factors. Extrinsic factors include the already mentioned taphonomic conditions, as well as soil type and characteristics (Hedges and Millard, 1995; López-Costas et al., 2016), environment (Manifold, 2012), bioturbation (Pokines and Baker, 2014) and duration of interment (Hedges and Millard, 1995). Intrinsic factors include bone size, density, porosity and the presence of pathological lesions (Manifold, 2012). Finally, the post-exhumation, processing, studying and curation of bone can also provide taphonomic alterations (Stodder, 2008). Good preservation and eventual fossilization is possible, yet very rare (Nielsen-Marsh et al., 2007).

The important Roman city of *Bracara Augusta* (current Braga, Portugal) had one of its necropolises located along the Via XVII, a road leading to *Asturica Augusta* (current Astorga, Spain) (Braga, 2010). This nucleus of the Via XVII necropolis saw the exhumation of many cremation (137 burials and 107 *ustrina*) and inhumation depositions. This work preliminarily analyzes eight cremation funerary depositions from the mid-1st to the early 3rd centuries c.e. (see also Marado and Braga, 2018), which was the only locally identified funerary practice at the time. The 4th century sees inhumations appear and replace cremation as the major funerary deposition during the 5-7th centuries.

This paper aims to (1) analyze the identifiable cremains preservation and the fragmentation of the cremains and (2) interpret the results in light of the known variations in funerary gestures and post-depositional taphonomic changes.

Sample

Eight cremation depositions were randomly selected for preliminary study, limited by time availability. Seven cremation burials (C007, C010, C018, C025, C057, C058, C063) and one *ustrinum* (or possible *bustum*; U084) were included (see Marado and Braga, 2018). Age estimation and sex diagnosis (see Marado and Braga, 2018) showed these depositions (each deposition's MNI = 1) included one non-adult individual and seven adult individuals (one of which was likely female; the six remaining depositions were of unknown sex). The stratigraphic units (SUs) that include human osteological material are listed in Table 1, along with information about their type of deposition and whether they were disturbed or sealed.

The site of the necropolis saw a long continued occupation, which was evidenced by a complex and diversified stratigraphical context. However, the levels concerning the necropolis were very well preserved, since it was possible to conclude the cremation and inhumation depositions were not subjected to any looting or destruction after their implantation.

Cremation depositions were located next to the edge of the Roman road, implanted in distinct levelling landfills of essentially sandy matrix. Despite this, the older graves were occasionally placed in the granitic substrate. The spatial distribution of the studied cremation depositions was rather distinct from that of inhumation depositions. Inhumations were preferably placed in the southern platform of the road, between 20 to 28 meters off (Braga, 2010).

Grave goods were characterized by their diversity in forms and materials. Beyond *lucernae*, ointment jars (*unguentaria*), bowls and pots, dozens of urns were exhumed. These urns were usually of common pottery, of either indigenous or Roman production, and frequently were the only identified grave goods. The exception was an oval-shaped granite urn (0.7 m tall) sealed with steel clamps enveloped in lead. Albeit their fragmentation, the same types of grave goods were found for inhumations, coupled with the identification of hundreds of metallic finds, such as nails (Braga, 2010; Martins et al., 2010).

Table 1 - Stratigraphic unit (SU) type and condition for analyzed depositions.

Deposition	SU	SU type	Disturbed	Sealed
C007	399	Bone and ash redeposition	No	-
	4426	Urned	No	Yes
C010	871	Unurned	No	-
	875	Unurned	No	-
	4419	Urned	No	Yes
C018	2570	Bone and ash redeposition	No	-
	2570*	Urned (small container)	No	No
C025	4430	Urned	No	Yes
C057	2340	Bone and ash redeposition	No	-
C058	2805	Bone and ash redeposition	No	-
	4230	Unurned	No	-
	4349	Urned	Fragmented urn	Yes
C063	4455	Urned	Slightly fragmented urn	Yes
	3916	Bone and ash redeposition	No	-
U084	1934	Unurned	No	-

*Small container filling; -: Not applicable.

Methods

The Anatomical Preservation Index (API) was scored for each bone or anatomical region of every deposition, according to methodology developed by Bello and Andrews (2006). This method relies on six classes of preservation (1 = 0%; 2 = 1-24%; 3 = 25-49%; 4 = 50-74%; 5 = 75-99%; 6 = 100%), each describing an interval including the estimated proportion of preservation of the identifiable bone. Given that many cremains fragments were not identifiable, the API will reflect the identifiable preservation, *i.e.*, the preservation of bone fragments which could be identified and thus subjected to a more thorough bioanthropological analysis. Since the preservation of unidentified cremains, or of cremains not selected for inclusion within secondary depositions, cannot be calculated, these cremains were not taken into account due to taphonomic alterations (such as anthropic choices [funerary gestures]; exposure to heat; manipulation; cremains' excavation and treatment, etc.).

Bone fragmentation was scored through (1) the measurement (in mm) of the largest fragment in each SU and deposition and (2) weighing the bone fragments after sieving them and dividing them into different size classes: small (>2 mm and <4 mm), medium (>4 mm and <10 mm) and large (>10 mm). The method was adapted from previous approaches to weighing modern cremains (see McKinley, 1993); this adaptation was mainly related to the exclusion of cremains smaller than 2 mm (which are very difficult to separate from sediment and are frequently excluded from cremains weight analysis; see Gonçalves, 2011; Marado and Braga, 2018) and the replacement of a 5mm mesh with a 4 mm mesh, due to availability. This latter change was negligible, since the discussion focuses mostly on the small (>2 mm) and the large (>10 mm) fragments.

The relationship between identifiable cremains preservation and fragmentation was tested using Kendall's τ-b rank correlation coefficient. The correlations between the summed API classes for all bones in each deposition, and the size of the largest fragment, the weight of all cremains, and the proportional weight of the different size classes defined above, were obtained.

Results

The Anatomical Preservation Index (API) of all identified bones is reported for each deposition included in Table 2. Generally, the bone preservation of identifiable fragments was low. Of the evaluated cases listed in Table 2, 46.9% corresponded to 0% preservation, while 51.3% of all cases were minimally preserved (1-24%). Only two cases (1.3%), a mandible and a set of clavicles, were preserved at 25-49%; a single set of clavicles (0.6%) was preserved at 50-74%.

Bone representation was addressed elsewhere (Marado and Braga, 2018), yet bone preservation of identifiable cremains per deposition can be gathered from Table 2. Only cranial bones were identified in every deposition, while only the sternum was not detected throughout all depositions. Vertebrae and ribs were represented in all but one deposition (87.5% of cases). Mandibles and hand bones were present in 75.0% of the depositions. Radii were identified in 62.5% of the analyzed cases. Scapulae, the pelvic girdle, humeri, femora and foot bones were detected in half the depositions. Clavicles and ulnae were present in 37.5% (n = 3) of the depositions. Tibiae and fibulae were represented in two depositions (25.0%). Finally, the sacrum and the patellae were identified on 12.5% (n = 1) of the studied contexts.

Table 2 also includes the sum of the API classes listed for each bone, as a simple representation of the general identifiable cremains preservation of each deposition. C007 (summed API = 41) and C010 (summed API = 36) were the generally more preserved individuals, while C018 (summed API = 21) and C057 (summed API = 26) were the worst preserved.

Table 3 reports the size of the largest fragment in each stratigraphic unit (SU) and the proportion of the cremains' weights caught on the 2 mm, 4 mm and 10 mm meshes during sieving, as well as their total weight. The means of each SU condition (urned, unurned and bone and ash redeposition) for secondary depositions are also given.

Table 2 - Preservation of each identifiable bone or anatomical region of the analyzed depositions.

	C007	C010	C018	C025	C057	C058	C063	U084
Cranium	1-24%	1-24%	1-24%	1-24%	1-24%	1-24%	1-24%	1-24%
Mandible	25-49%	1-24%	0%	1-24%	0%	1-24%	1-24%	1-24%
Cervical vertebrae	1-24%	1-24%	0%	1-24%	1-24%	1-24%	1-24%	1-24%
Thoracic vertebrae	1-24%	1-24%	0%	1-24%	1-24%	1-24%	1-24%	1-24%
Lumbar vertebrae	1-24%	1-24%	0%	1-24%	1-24%	1-24%	1-24%	1-24%
Sacrum	1-24%	0%	0%	0%	0%	0%	0%	0%
Scapulae	1-24%	1-24%	0%	1-24%	0%	1-24%	0%	0%
Clavicles	50-74%	25-49%	0%	1-24%	0%	0%	0%	0%
Ribs	1-24%	1-24%	0%	1-24%	1-24%	1-24%	1-24%	1-24%
Sternum	0%	0%	0%	0%	0%	0%	0%	0%
Os coxae	1-24%	1-24%	0%	0%	0%	1-24%	1-24%	0%
Humeri	1-24%	1-24%	0%	1-24%	0%	0%	0%	1-24%
Radii	1-24%	1-24%	0%	1-24%	0%	1-24%	1-24%	0%
Ulnae	1-24%	0%	0%	0%	0%	1-24%	1-24%	0%
Hand bones	1-24%	1-24%	0%	1-24%	1-24%	1-24%	1-24%	0%
Femora	1-24%	1-24%	0%	1-24%	0%	0%	0%	1-24%
Patellae	0%	0%	0%	0%	0%	1-24%	0%	0%
Tibiae	1-24%	1-24%	0%	0%	0%	0%	0%	0%
Fibulae	1-24%	0%	0%	0%	0%	1-24%	0%	0%
Foot bones	1-24%	1-24%	0%	0%	0%	1-24%	1-24%	0%
Summed API classes*	41	36	21	32	26	34	31	28

*Sum of the preservation classes (1 = 0%; 2 = 1-24%; 3 = 25-49%; 4 = 50-74%; 5 = 75-99%; 6 = 100%) of every bone for each deposition; the minimum possible score is 20, and the maximum is 120.

Table 3 - Fragmentation of the osteological material on the stratigraphic units (SUs) of the analyzed depositions.

	SU	Largest fragment size mm	Small %	Medium %	Large %	Weight g
C007	399§	32.86	28.4	43.8	27.7	250.8
	4426#	83.04	10.6	12.2	77.2	884.3
C010	871+	30.00	1.4	28.2	70.4	6.7
	875+	23.92	16.0	39.9	44.1	21.2
	4419#	82.03	2.4	11.7	86.0	691.5
C018	2570§	22.17	29.4	17.6	52.9	2.8
	2570<(#)	8.62	0.0	100	0.0	0.1
C025	4430#	43.42	3.8	25.7	70.5	251.4
C057	2340§	64.17	2.6	42.9	54.4	599.1
C058	2805§	62.66	1.9	20.7	77.4	215.2
	4230+	57.48	2.2	38.4	59.4	256.7
	4349#	34.41	4.2	32.2	63.6	26.2
C063	3916§	49.76	3.3	39.0	57.7	964.0
	4455#	48.17	7.0	13.2	79.7	38.3
U084	1934↔	34.84	5.3	27.4	67.3	119.3
Means*	Urned	58.21	5.6	19.0	75.4	378.3
	Unurned	37.13	6.5	35.5	58.0	94.9
	Redepositions	40.04	10.9	44.0	45.0	338.7

Small: between 2 mm and 4 mm; medium: between 4 mm and 10 mm; large: >10 mm; <: small container filling; #: urned deposition; +: unurned deposition; §: bone and ash redeposition; ↔: bone and ash primary deposition. *Means do not include SU 1934, since it was the only primary deposition (*ustrinum*/*bustum*). All fragments from SU 2570 are considered bone redepositions for the calculation of the means, since the filling of the small container could not be distinguished from the remaining SU 2570 and could be unintentional.

Fragmentation comparisons between contexts can be affected by body mass, since larger bones may provide larger fragments than smaller bones when subjected to the same processes. As noted earlier, size, density and porosity of bone are parts of the intrinsic factors affecting taphonomic alterations (Manifold, 2012). Body mass differences reflect those bone characteristics; so, body mass is an intrinsic factor in taphonomic alterations. However, it should be noted that currently available methods to analyze fragmentation have been criticized for not providing comparable results if the individuals are not of equal body mass (see Gonçalves and Pires, 2016). Therefore, results should be interpreted with caution, since they provide only an approximation to fragmentation.

The largest fragment size varied between 8.62 mm (SU 2570 [small container], C018) and 83.04 mm (SU 4426, C007); the largest fragments presented the lowest mean for unurned cremains (37.13 mm), and the highest for urned cremains (58.21 mm).

The smallest studied fragments (those between 2 mm and 4 mm) were absent from SU 2570 (small container; C018) and had the highest proportion of 29.4% for SU 2570 (29.4%; C018). The mean proportion of small fragments was highest on bone and ash redepositions (10.9%), and lowest for urned cremains (5.6%).

Medium sized cremains (>4 mm and <10 mm) represented from 11.7% (SU 4419, C010) to 100% (SU 2570 [small container], C018) of the SUs cremains. Medium fragments averaged 44% on redepositions, which presented the contexts with higher mean representation of these type of remains. The lowest mean representation was found for urned cremains (19%).

Cremains retained by the 10 mm mesh varied from 0% (SU 2570 [small container], C018) to 86% (SU 4419, C010) in proportion. These larger cremains averaged 75.4% in the urned cremains and only 45% in bone and ash redepositions (Table 3).

The weight of the cremains for each SU varied from 0.1 g (SU 2570 [small container], C018) to 964 g (SU 3916, C063). Unurned cremains showed an apparently much lower mean weight (94.9 g) than redepositions (338.7 g) and especially urned cremains (378.3 g).

Table 4 – Fragmentation of the osteological material on the analyzed depositions.

	Largest fragment size	Small (%)	Medium (%)	Large (%)	Weight (g)
C007	83.04	14.4	18.9	66.7	1135.1
C010	82.03	2.8	12.6	84.6	719.4
C018	22.17	28.6	20.0	51.4	2.9
C025	43.42	3.8	25.7	70.5	251.4
C057	64.17	2.6	42.9	54.4	599.1
C058	62.66	2.2	30.4	67.4	498.1
C063	49.76	3.4	38.2	58.4	1002.3
U084	34.84	5.3	27.4	67.3	119.3

Small: between 2 mm and 4 mm; medium: between 4 mm and 10 mm; large: >10 mm.

Table 4 reports the same data as Table 3 (the size of the largest fragment, proportion of weights from each mesh and total weight), yet focuses on complete depositions.

The largest fragment was smallest in C018 (22.17 mm) and largest in C007 (Table 4), as seen in Table 3. The amplitude of variation for cremains of different sizes is naturally diminished, since the data for depositions pooled the data for their SUs. The highest and lowest proportions were: (a) 2.2% (C058) and 28.6% (C018) for small cremains; (b) 12.6% (C010) and 42.9% (C057) for medium cremains; and (c) 51.4% (C018) and 84.6% (C010) for large cremains. Cremains' weights for each deposition were highly variable, between 2.9 g (C018) and 1135.1 g (C007).

The correlations between summed API classes for each deposition and the variables in Table 4 were computed. They were positive and significant for the correlation with size of the largest fragment ($\tau = 0.643$; $p = 0.026$) and cremains' weight ($\tau = 0.571$; $p = 0.048$), as was predictable, since successful anatomical identification increases with greater bone quantity and larger fragment size. The correlation between summed API classes and the proportion of large fragments was also significant ($\tau = 0.571$; $p = 0.048$), as opposed to the smallest ($\tau = -0.143$; $p = 0.621$) and medium ($\tau = -0.357$; $p = 0.216$) cremains, which resulted in not significant, yet negative, coefficients.

Discussion

Overall identifiable cremains preservation of the sample was low (Table 2), yet higher than that found for inhumations in the same context, which was likely caused by changing soil humidity across the year and soil acidity (Marado et al., 2017). Via XVII inhumations (n = 25; 3-7th centuries c.e.) were very poorly preserved, which was reflected in the API classes found (only classes 1 [0% of bone preserved] and 2 [1-24% of bone preserved] were identified). Superior bone preservation occurred on all graves, the structures of which limited the contact with sediment or water flow; graves without such limiting structures showed skeletal preservation on only 43.8% of cases (Marado et al., 2017). This was likely due to the local soil environment. Braga's soils are of granitic origin (Costa et al., 1998; Vieira et al., 2011), so typically acidic and low on nutrients (Osman, 2013). Temperatures are typically mild and precipitation varies greatly depending on the season (see the 1971 to 2000 "Climate normals" for Braga: http://www.ipma.pt/en/oclima/normais.clima/1971-2000/004/).

Cycles of wetting and drying promote bone decomposition, mainly because water subsequently absorbs nutrients during each cycle (Hedges and Millard, 1995; Turner-Walker, 2008; Surabian, 2012; Huisman et al., 2017) and fluctuating humidity promotes prejudicial microbial activity (Nielsen-Marsh and Hedges, 2000; Smith et al., 2007; Turner-Walker, 2008; Surabian, 2012). Low pH levels in the soil again promote decomposition (Nielsen-Marsh et al., 2007; Smith et al., 2007; López-Costas et al., 2016). Recrystallization is facilitated (Manifold, 2012) and the typically low nutrient levels in acidic soils are supplemented through the exploitation of bone nutrients (Crow, 2008; Forbes, 2008; Latham and Madonna, 2014).

In Via XVII inhumations, these factors were mediated by structural traits of the inhumation depositions; namely, sealed undisturbed boxes and the presence of gable roofs prevented decomposition by avoiding contact between bone and sediment and between bone and flowing water (Marado et al., 2017). The case for cremations may be different, since bone exposed to high temperature recrystallizes and loses organic matter and humidity (Fairgrieve, 2008), making it less appropriate for microbial activity related to bone decomposition. These chemical and structural alterations facilitate, as stated before, the preservation of cremains over that of bone not exposed to high temperatures in harsh taphonomic environments (Mays, 1998).

The pattern of bone preservation and identification shows some bones were either never or rarely identified within each deposition, namely the sternum, the sacrum, patellae, tibiae and fibulae (Table 2). Lower proportions of preserved and identifiable fragments for some bones hinder the analysis of anatomical representation and their distribution along urns (attempted by Marado and Braga, 2018).

Fragmentation does not occur solely as a result of cremation, but also of the manipulation, deposition and even post-exhumation treatment and study of the cremains (McKinley, 1994; Gonçalves et al., 2010; Gonçalves and Pires, 2016). Results show urned cremains were less fragmented than unurned and redeposited cremains, since they present the highest mean for largest fragment, the lowest mean proportion for small cremains and the highest mean proportion for large cremains (Table 3). The reported correlation coefficients show preservation (cremains fragments allowing individual identification to a specific bone) was significantly higher when a greater proportion of bone was of larger size (>10 mm). So, as expected, deposition contexts which were less prone to fragmentation preserved identifiable bones in greater quantity. This is a natural consequence, since identification is harder the more fragmented and deformed bones are (Gómez Bellard, 1996). Urned cremains apparently were less fragmented, which suggests structures that reduce contact with acidic soils and with flowing water prevent bone decomposition in cremated depositions, much like what was found for Via XVII necropolis nucleus inhumations (Marado et al., 2017). This finding was apparently supported by the pattern found within the studied urns: when cremains from undisturbed urns (including a slightly disturbed urn) were compared with those from a disturbed urn (C058 - SU 4349; see Table 1), fragmentation was apparently greater in the latter. The largest fragment (34.41 mm) and the proportion of large fragments (>10 mm = 63.6%) were smaller than the mean proportions for urned cremains (largest fragment = 58.21 mm; >10 mm = 75.4%). McKinley (1994) found the same pattern showing lidded or waterlogged cremains preserved the same dimensions as contemporary cremations after collection (see McKinley, 1993), unlike unlidded or unurned cremains; McKinley (1994) concluded soil characteristics and dynamics promoted fragmentation.

The biological profiles of the individuals and the funerary gestures leading to their depositions (see Marado and Braga, 2018) could represent factors influencing fragmentation and identifiable cremains preservation, which pertinence will be discussed in the following paragraphs.

A possible female individual is represented by the cremains from deposition C007, yet no sexual diagnosis was possible for any other assemblage (see Marado and Braga, 2018), which precludes any sex-based comparisons on differential fragmentation and/or preservation. C007 shows high identifiable cremains preservation (for the present sample; Table 2) and average fragmentation (Table 4).

A non-adult individual was identified in deposition C018, while all other depositions were likely of adult individuals (Marado and Braga, 2018). The results (Tables 2, 3 and 4) show only cranial bones were preserved and identifiable. The C018 deposition was also the lightest (only 2.9 g), more fragmented (smallest size of the largest fragment, highest proportion of small cremains and lowest proportion of large cremains) and less preserved deposition, which is likely related to lack of skeletal maturity, size and robustness.

The remains from the only analyzed *ustrinum* (or *bustum*)(U084), also show a small largest fragment, yet its cremains' fragmentation was average when compared to that of the other depositions, and above average if compared to cremains from bone and ash redepositions. The displacement and manipulation of hot cremains (and of cremains even after cooling) results in further fragmentation, besides the breakage related to the exposure to high temperatures (McKinley, 1993). The fragmentation observed for U084 seems to support that conclusion. Preservation of identifiable cremains was low on this primary deposition, as well as cremains' weight. If this context corresponds to a *bustum*, and so there was no transference of fragments to another context, this low preservation and weight could underline the role of the environment (fluctuating humidity and high acidity) in bone decomposition, even in cremains. Yet, this context could also correspond to an *ustrinum* used only once or used for one last time after being cleaned (Marado and Braga, 2018), which would justify the low bone weight through transference. Cremation depositions of Encosta de Sant'Ana showed a different pattern, since the fragmentation of a *bustum* was much higher than that of most urned depositions (Gonçalves et al., 2010), underlining the need for further analyses.

Depositions where bones were exposed to temperatures lower than 650 ºC (250 to 600 ºC, according to their color and to Etxeberria, 1994; see Marado and Braga, 2018), namely C058, C063 and U084, do not seem to present any particular pattern of preservation (Table 2) or fragmentation (Table 4). Since these depositions were not exposed to temperatures as consistently high as other depositions, according to the available evidence, they could present lower fragmentation and identifiable cremains preservation; yet, this was not confirmed.

Selective or negligent bone transference to the deposition (Gonçalves et al., 2015) seems to have occurred in at least six cases (C010, C018, C025, C057, C058, U084), due to their low weight when compared to modern references (McKinley, 1993; Gonçalves et al., 2013). This selection or negligence could be unrelated to fragmentation, since these depositions present variable results, as do the remaining cases, C007 and C063 (Table 4). Fragmentation could also have been worsened by the burial, soil contact, excavation, transportation and study of the materials, which hinders the strength of the previous interpretation. Preservation, however, was higher on average for C007 and C063, when compared to the depositions showing evident incomplete transference (Table 2), as expected for selected or negligent bone recovery from the *ustrinum*. The non-adult individual (C018) could show very low preservation due to its young age and lower body mass. In that particular case, selective or negligent bone transference was impossible to ascertain, since the aforementioned intrinsic factors could affect fragmentation and preservation of identifiable cremains.

Two depositions (C018 and C057) did not include urned cremains (C018 included a small votive vessel with few cremains, which were likely accidentally introduced during bone and ash redeposition). These depositions, while differing a lot in the proportion of smaller fragments (>2 mm) and size of the largest fragment, both present the lowest proportion of larger fragments (>10 mm) (Table 4) and the lowest preservation (Table 2). As noted early on in the Discussion, stratigraphic units with unurned cremains and cremains from bone and ash redepositions show more fragmentation than SUs with urned cremains. This was supported by the low proportion of larger fragments and low preservation in C018 and C057. However, the case of C018 is particular. Since C018 represents a non-adult individual, small fragment size could be related to the lower body mass of the individual at death, when compared to the body mass of adults. The concurrent role of post-depositional taphonomy in increasing fragmentation was therefore difficult to ascertain.

Conclusion

A great number of cremation depositions from the Via XVII necropolis nucleus of Bracara *Augusta* was recovered in recent excavations (2008-2010 and 2016-2017). Despite the presence of harsh diagenetic conditions ⍰ namely provided by fluctuating water flow and acidic soils ⍰ and the fragmentation caused by exposure to high temperatures, cremation promotes preservation when compared to inhumation in the same context. The preserved osteological material is usually very fragmented, yet resists better to decomposition.

Funerary gestures have relevance to the preservation and fragmentation of osteological materials. Unurned cremains or redepositions of bone and ash showed higher fragmentation; likewise, depositions without urns showed lower preservation. Urned cremains and primary depositions were less fragmented, suggesting this was likely due to their shelter from environmental conditions and to not being moved, respectively. Some depositions seemed to only partially represent the deceased, as their weight was not equivalent to that of a complete cremated skeleton. Hindered preservation in such cases is consistent with the interpretation of selective or negligent recovery of bones from the pyre and suggests that funerary behavior can be as detrimental for skeletal representation and preservation.

Further research on the abundant and varied cremation depositions from the necropolis nucleus of Via XVII, *Bracara Augusta*, is encouraged. This collection is likely to shed light on taphonomic traits of cremains in these and similar environmental contexts and funerary rituals. Testing the tentative conclusions proposed here will allow inferring the taphonomic processes promoting cremains' decomposition and fragmentation. This knowledge will facilitate the planning of the bioarchaeological excavation of cremated remains in the field and the laboratory, by acknowledging the typical preservation status of cremation and inhumation remains in this context, therefore allowing the preparation of an approach that allies systematic, timely excavation with the promotion of appropriate care in the study and curation of the remains.

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