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# BONE DIAGENESIS IN *VIA XVII* INHUMATIONS (BRACARA AUGUSTA): IDENTIFICATION OF TAPHONOMIC AND ENVIRONMENTAL FACTORS IN DIFFERENTIAL SKELETAL PRESERVATION

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**Abstract:**

Bone decomposition in archaeological contexts is differential and dependent on geological and taphonomic variables. The present work analyses evidences of skeletal diagenesis in 25 inhumations (3rd-4th to 5th-7th centuries) from the *Via XVII* necropolis of *Bracara Augusta* (Braga, Portugal).

*Bracara Augusta* is located in the Minho region, Northwest Portugal. Minho's granitic soils are characterized by high acidity. Precipitation is high in cold seasons and markedly reduced in the summer. The influence of these factors on bone preservation of *Via XVII* inhumations was analyzed through the comparison between graves with different structural traits (box presence, box material, sediment presence, chronology, coffin/stretcher presence or material, and cover presence or type), using the *chi* squared test. None of the comparisons showed significant differences in skeletal preservation frequencies. Yet, the comparison between graves that structurally limit skeletal contact with sediment (sealed/undisturbed boxes) or water flow (gable roof boxes) (100%) and the remaining graves (43.8%) presented significantly different frequencies ($\chi^2 = 7.910$; $p = 0.005$).

The taphonomic conditions of *Via XVII* inhumations are inadequate for bone preservation. In graves preserving osteological material, the presence of a box structure is essential, yet only of determining influence if kept sealed or covered with a gable roof. The continued study of taphonomic factors influencing bone diagenesis will allow the preparation of archaeological excavations in Braga funerary contexts to account for the needed specialists and materials.

**Palavras-chave:** Bioarchaeology; Funerary archaeology; Bone decomposition; Late Roman/paleochristian.

**Resumo:**

**Diagénese óssea em inumações da *Via XVII* (*Bracara Augusta*): Identificação de fatores tafonómicos e ambientais na preservação esquelética diferencial**

A decomposição dos ossos em contexto arqueológico é diferencial, dependente de variáveis geológicas e tafonómicas. O presente trabalho analisa evidências relativas à diagénese esquelética em 25 inumações (séculos III-IV a V-VII) da necrópole da *Via XVII* de *Bracara Augusta* (Braga).

*Bracara Augusta* localiza-se no Minho, região no noroeste de Portugal Continental de solos graníticos caracterizados por elevada acidez. A precipitação é elevada nas estações frias, reduzindo-se marcadamente em períodos quentes. A influência destes fatores na preservação óssea das inumações escavadas na *Via XVII* foi pesquisada pela comparação entre sepulturas de diferentes características estruturais (presença de caixa, material da caixa, contacto com sedimento, cronologia, presença de caixão/padiola, tipo e presença de cobertura), recorrendo ao *chi* quadrado. Nenhuma das comparações revelou diferenças significativas nas frequências de preservação esquelética. No entanto, a comparação entre sepulturas de estrutura limitadora do contacto com sedimento (caixas seladas/não perturbadas) ou do fluxo de água (caixa com cobertura de duas águas) (100%) com as restantes sepulturas (43,8%) revelou frequências significativamente diferentes ($\chi^2 = 7{,}910$; $p = 0{,}005$).

As condições tafonómicas das inumações da *Via XVII* são inadequadas para a preservação óssea. Nos casos em que se preservam evidências osteológicas, a presença de estrutura em caixa é fundamental, mas só tem influência determinante se se mantiver selada ou tiver cobertura de duas águas. A continuação do estudo dos fatores tafonómicos que mediam a diagénese óssea permitirá que a preparação das escavações arqueológicas de contexto funerário em Braga determine os especialistas e instrumentos adequados ao projeto.

**Keywords:** Bioarqueologia; Arqueologia funerária; Decomposição óssea; Período tardo-romano/paleocristão.

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## 1. INTRODUCTION

Bone preservation and diagenesis is highly variable in archaeological contexts. Diagenetic alterations are related to extrinsic factors, such as (1) soil type and characteristics (particle size, composition, humidity, or acidity) (HEDGES & MILLARD 1995; LÓPEZ-COSTAS *et al.* 2016), (2) funerary gestures (treatment previous to deposition, type of deposition, depth, and occurrence of funerary recipient or grave goods) (JANS *et al.* 2004; POKINES & BAKER 2014), (3) environment (temperature, rainfall) (MANIFOLD 2012), (4) bioturbation (influence of plant roots, burrowing animals and annelids) (POKINES & BAKER 2014) and (5) time length of interment (HEDGES & MILLARD 1995). These alterations are also mediated by bone characteristics (intrinsic factors), such as size, density, porosity, or the occurrence of pathology (MANIFOLD 2012).

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After interment, osteological materials are unlikely to preserve for extended lengths of time, so ultimately leave very little trace due to their decomposition. Bone that undergoes funerary treatment (such as cremation: MAYS, 1998) before deposition is more likely to endure. Under good conditions, bone can be well preserved and even fossilize, yet this is a rare outcome (NIELSEN-MARSH *et al.* 2007). In archaeological excavations of funerary contexts it is important to predict the existence and the conditions of bone, since these factors are related with excavation length and which staff and materials (for excavation and preservation) are needed.

The aim of this work is to understand the factors affecting bone preservation in the Late Roman and early post-Roman inhumations of the *Via XVII* necropolis of *Bracara Augusta*, in current Braga, northern Portugal (Northwest Iberian Peninsula).

## 2. MATERIALS AND METHODS

Twenty-five inhumations were excavated in the Roman city of *Bracara Augusta*, from the *Via XVII* necropolis (Figure 1). *Via XVII* was the road connecting *Bracara Augusta* (current Braga) to *Asturica Augusta* (current Astorga). These inhumations are dated from 4$^{th}$ to 6/7$^{th}$ centuries CE (Late Roman to early post-Roman periods) through archaeological materials and absolute dating (see BRAGA 2010; MARTINS *et al*. 2009). The archaeological campaigns that obtained the present data took place in the last decades. Besides inhumations, 244 depositions related to cremation rituals (1$^{st}$ to 5$^{th}$/7$^{th}$ centuries CE) were found, yet are not studied in this work due to their different pre-deposition treatment (cremation at temperatures over 600ºC), which can enhance bone preservation (MAYS 1998).

The *Via XVII* inhumations are divided in seven types (and several subtypes) of graves, according to the structures and materials surrounding the deposition (Table 1; Figure 2). Four inhumations were either disturbed or could not be evaluated in full due to the physical limits of the archaeological excavation. In those instances, the inhumations were considered of undetermined type and subtype.

Preservation was initially described using Bello and Andrew's (2006) six-class method, the Anatomical Preservation Index (API). The API found was dichotomous, since bones were either absent (API class 1: 0% of bone preserved) or poorly preserved (API class 2: 1-24% of bone preserved). Further considerations made use of this dichotomy in a simplified form, identifying skeletons as either absent (0% preservation) or poorly preserved (1-24% preservation) within each grave.

The generalized poor preservation of the inhumed remains made it impossible to estimate the biological profile (sex, age or morphological characteristics).

Relationships between skeletal preservation and the different grave variables (including: box presence, box material, deposition cover, chronology, wood/lead coffin/stretcher presence, sediment infiltration; see Table 2) were tested using the chi squared ($\chi^2$) test.

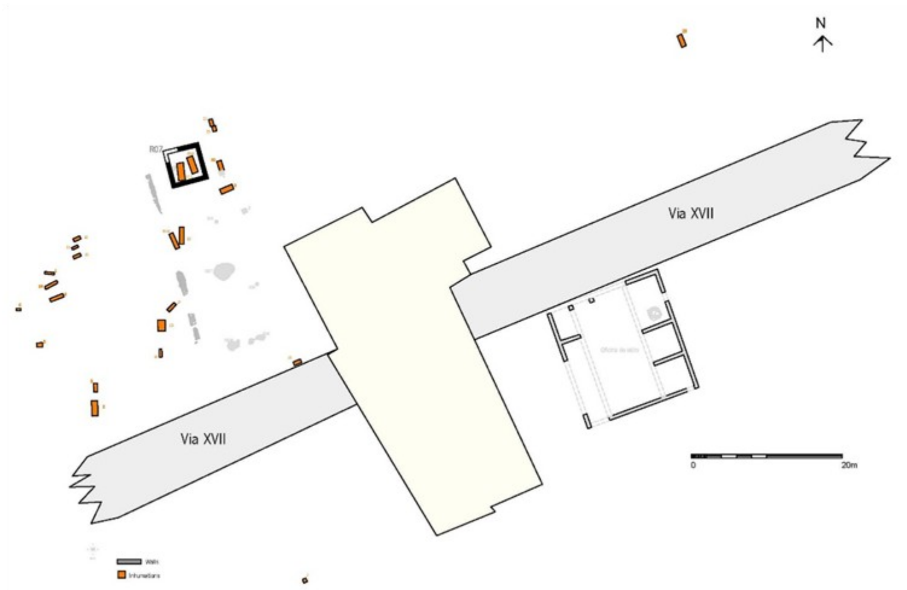


**Fig. 1.** Map of *Via XVII* showing known structures (inhumations, road and walls).
**Fig. 1.** Mapa da *Via XVII* com representação das estruturas conhecidas (inumações, via e paredes).

**Tab. 1.** Inhumation identification, type, chronology, skeletal API (Anatomical Preservation Index) and site acronym for the *Via XVII* necropolis.
**Tab. 1.** Identificação das inumações, e seus tipo, cronologia, API (Índice de Preservação Anatómico) esquelético e acrónimo de sítio na necrópole da *Via XVII*.

| ID | Type | Relative chronology | API | Acronym |
|---|---|---|---|---|
| I001 | 3A | 5th-7th century | 1-24% | CTT/LSF |
| I002 | 3A | 5th-7th century | 1-24% | CTT/LSF |
| I003 | 3A | 5th-7th century | 1-24% | CTT/LSF |
| I004 | 3B | 5th-7th century | 1-24% | CTT/LSF |
| I005 | 4A | 4th-5th century | 1-24% | CTT/LSF |
| I006 | 1A | 4th-5th century | 1-24% | CTT/LSF |
| I007 | 4A | 4th-5th century | 0% | CTT/LSF |
| I008 | 5B | 4th-5th century | 1-24% | CTT/LSF |
| I009 | 7B | 5th-7th century | 1-24% | CTT/LSF |
| I010 | 2A | 4th-5th century | 0% | CTT/LSF |
| I011 | 5A | 4th-5th century | 1-24% | CTT/LSF |
| I012 | 4A | 4th-5th century | 0% | CTT/LSF |
| I013 | 4D | 4th-5th century | 1-24% | CTT/LSF |
| I014 | 4E | Second half of 3rd-Early 4th cent. | 1-24% | CTT/LSF |
| I015 | 7A | 4th-5th century | 1-24% | CTT/LSF |
| I016 | Undetermined | 4th-5th century | 0% | CTT/LSF |
| I017 | 4B | 4th-5th century | 1-24% | CTT/LSF |
| I018 | 4B | 4th-5th century | 0% | CTT/LSF |
| I019 | Undetermined | 4th-5th century | 0% | CTT/LSF |
| I020 | Undetermined | Second half of 3rd-Early 4th cent. | 1-24% | CTT/LSF |
| I021 | 6A | 4th-5th century | 0% | CTT/LSF |
| I022 | 5C | 5th-7th century | 1-24% | CTT/LSF |
| I023 | Undetermined | 4th-5th century | 0% | TAVL |
| I024 | 1A | 5th-7th century | 0% | CTT/LSF |
| I025 | 5D | 4th-5th century | 1-24% | CTT/LSF |

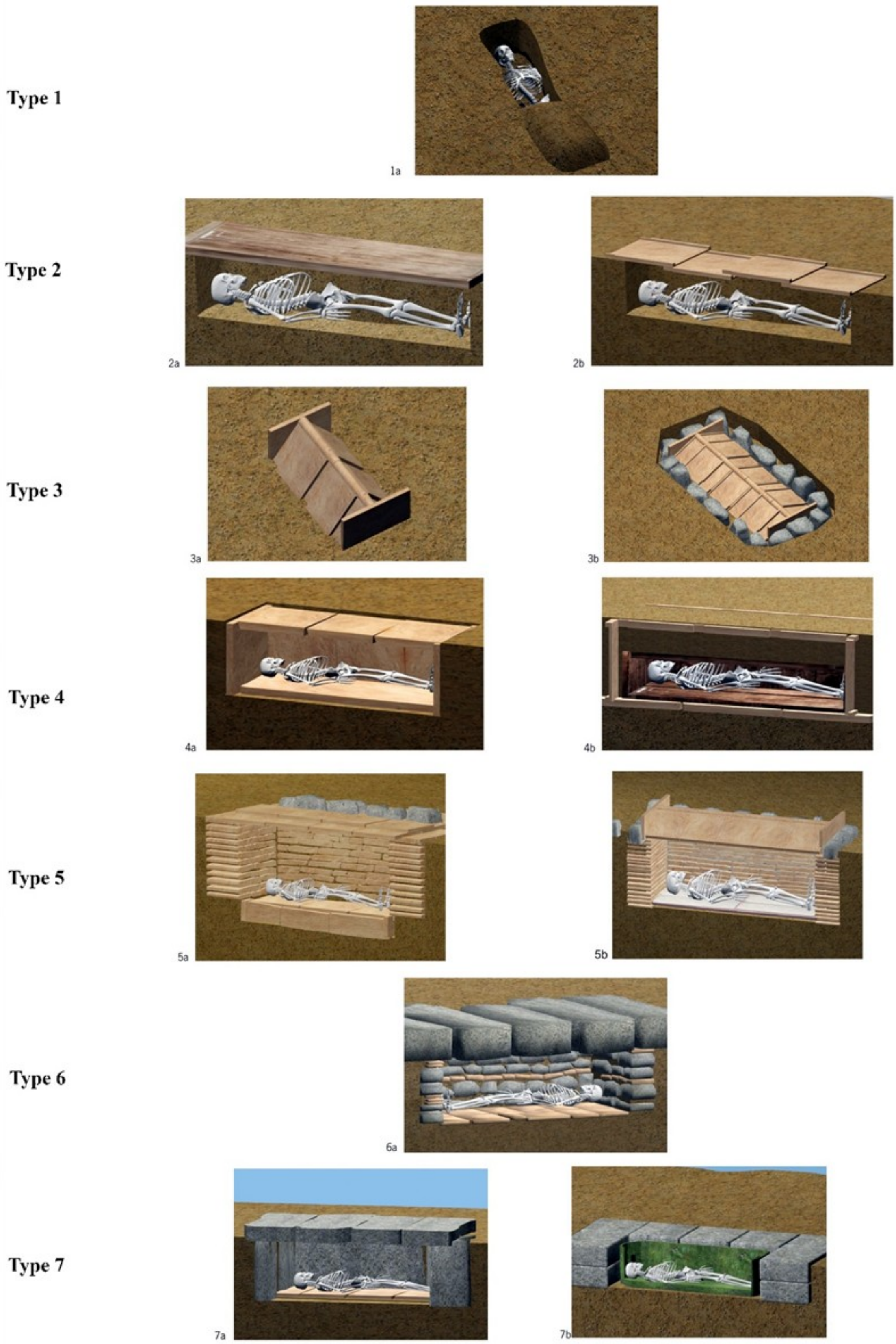


**Fig. 2.** Types and subtypes of *Via XVII* inhumations structures (BRAGA 2010).
**Fig. 2**. Tipo e subtipos das estruturas de inumação da *Via XVII* (Braga 2010).

**Tab. 2.** Inhumation identification and structural characterization according to the variables pertinent to bone diagenesis.
Tab. 2. Identificação das inumações e sua caracterização estrutural de acordo com as variáveis pertinentes para a diagénese óssea.

| ID | Box presence | Box material | Cover | Coffin/stretcher | Sediment infiltration |
|---|---|---|---|---|---|
| I001 | Yes | Brick/*tegulae* | Brick gable roof | None | Yes |
| I002 | Yes | Brick/*tegulae* | Brick gable roof | Wood stretcher | Yes |
| I003 | Yes | Brick/*tegulae* | Brick gable roof | None | Yes |
| I004 | Yes | Brick/*tegulae* | Brick gable roof | None | Yes |
| I005 | Yes | Brick/*tegulae* | Brick/*tegulae* | None | Yes |
| I006 | No | None | None | None | Yes |
| I007 | Yes | Brick/*tegulae* | Brick/*tegulae* | None | Yes |
| I008 | Yes | Brick/*tegulae* | Brick gable roof | Wood stretcher | Yes |
| I009 | Yes | *Stone* | Stone | Lead coffin | No |
| I010 | No | None | Brick/*tegulae* | Wood stretcher | Yes |
| I011 | Yes | Brick/*tegulae* | Brick/*tegulae* | None | No |
| I012 | Yes | Brick/*tegulae* | Brick/*tegulae* | None | Yes |
| I013 | Yes | Brick/*tegulae* | Brick gable roof | None | Yes |
| I014 | Yes | Brick/*tegulae* | Brick/*tegulae* | Wood stretcher | Yes |
| I015 | Yes | *Stone* | Stone | None | Yes |
| I016 | Yes | *Stone* | Stone | None | Yes |
| I017 | Yes | *Stone* | None | Wood coffin | Yes |
| I018 | Yes | Brick/*tegulae* | Brick/*tegulae* | Wood stretcher | Yes |
| I019 | Yes | Brick/*tegulae* | Brick/*tegulae* | None | Yes |
| I020 | Yes | Brick/*tegulae* | Brick/*tegulae* | None | Yes |
| I021 | Yes | *Stone* | Stone | None | Yes |
| I022 | Yes | *Stone* | Brick/*tegulae* | Wood stretcher | No |
| I023 | No | None | None | Wood coffin | Yes |
| I024 | No | None | Brick/*tegulae* | Wood stretcher | Yes |
| I025 | Yes | Brick/*tegulae* | Brick/*tegulae* | Wood stretcher | Yes |

## 3. RESULTS AND DISCUSSION

Twenty-five inhumation graves were excavated in Braga, in the new necropolis sector of *Via XVII* (see BRAGA 2010). Of these, sixteen graves (64%) preserved osteological material. The effect of grave structure variables (box presence, box material, sediment presence, chronology, coffin/stretcher presence or material, and cover presence or type) in skeletal preservation is analyzed in Table 3. All the results of chi squared tests are not statistically significant ($p > 0.05$). This suggests the different grave structural choices do not result in preservation frequencies that differ from the expected frequencies. Yet, this statistical interpretation is limited because of the small sample size.

Some results are interesting despite the non-significant $\chi^2$ results (Table 3). The frequency of graves with boxes that preserve skeletal material is much higher (71.4%) than the frequency of graves without boxes preserving bone (25%). The $\chi^2$ result (3.144; $p = 0.076$) approaches significance. Box materials do not seem to play a role in preservation, since stone (66.7%) and brick or *tegulae* (73.3%) present similar frequencies.

Cover types are fairly similar, since stone

**Tab. 3.** Bone preservation according to six variables and respective chi squared ($\chi^2$) test results.
**Tab. 3.** Preservação óssea de acordo com seis variáveis e respetivos resultados do teste chi quadrado ($\chi 2$).

| **Box presence** | **%** | **k/n** | **Sediment presence** | **%** | **k/n** |
|---|---|---|---|---|---|
| **Yes** | 71.4 | 15/21 | **Yes** | 59.1 | 13/22 |
| **No** | 25.0 | 1/4 | **No** | 100 | 3/3 |
| $\chi^2 = 3.144$ | p = 0.076 | | $\chi^2 = 1.918$ | p = 0.166 | |
| **Chronology** | **%** | **k/n** | **Box material** | **%** | **k/n** |
| **3rd-4th c.** | 100 | 2/2 | **Stone** | 66.7 | 4/6 |
| **4th-5th c.** | 50.0 | 8/16 | **Brick/*tegulae*** | 73.3 | 11/15 |
| **5th-7th c.** | 85.7 | 6/7 | **No box** | 25.0 | 1/4 |
| $\chi^2 = 3.919$ | p = 0.141 | | $\chi^2 = 3.226$ | p = 0.199 | |
| **Coffin/stretcher** | **%** | **k/n** | **Cover** | **%** | **k/n** |
| **Wood coffin** | 50.0 | 1/2 | **Brick gable roof** | 100 | 6/6 |
| **Lead coffin** | 100 | 1/1 | **Stone** | 50.0 | 2/4 |
| **Wood stretcher** | 62.5 | 5/8 | **Brick/*tegulae*** | 50.0 | 6/12 |
| **No coffin/stretcher** | 64.3 | 9/15 | **None** | 66.7 | 2/3 |
| $\chi^2 = 0.741$ | p = 0.864 | | $\chi^2 = 4.745$ | p = 0.191 | |

% - Percentage of inhumations with preserved osteological material; k - Number of inhumation graves with preserved osteological material; n - Number of inhumation graves in sample; $\chi^2$ - Chi squared test result; p - Probability value; c. - Century.

(50%) and brick/*tegulae* (50%) show equal result (curiously lower than the preservation in uncovered graves: 66.7%), yet gable roofs provide higher preservation (100%). Graves (without boxes or with disturbed/unsealed boxes) where bones were in contact with sediment show lower skeletal preservation (59.1%) than those void of sediment (100%). The use of coffins or stretchers does not seem to have an effect on bone preservation, since wood coffins (50%), wood stretchers (62.5%) and their absence (64.3%) present similar results.

Chronological differences are apparent due to the high preservation of older contexts (100% between the second half of 3$^{rd}$ century to early 4$^{th}$ century) which contrast with only half the graves showing preservation in 4$^{th}$/5$^{th}$ centuries (50%), while again more 5$^{th}$ to 7$^{th}$ century graves (85.7%) show skeletal preservation. There is no apparent reason for this variation. The chronological similarity between the phases suggest the variation may be random, supporting the statistical result of non-significance. The small number of graves from the first phase (second half of 3$^{rd}$ century to early 4$^{th}$ century) may also bias these results.

In Braga, soil diagenetic conditions promote bone dissolution. Soils are predominantly of granitic origin (COSTA *et al.* 1998; VIEIRA *et al.* 2011) and therefore usually acidic (with low pH) and low on nutrients (OSMAN 2013). Monthly average precipitation varies greatly throughout the year, from over 150 mm between October and February to below 80 mm between June and September in the years 1971 to 2000 (Figure 3). Temperatures are mild, with a yearly average of only 11.9 days with temperature below 0ºC and 29.3 days above 30ºC between 1971 and 2000 (according to the "Climate normals" for Braga: http://www.ipma.pt/en/oclima/normais.clima/1971-2000/004/). The effects of such soil acidity and cycles of soil humidification and dehumidification (due to the flow of water or the rising level of phreatic waters in winter) are detrimental to bone preservation (GORDON & BUIKSTRA 1981; CONARD *et al.* 2008; CROW 2008; HUISMAN *et al.* 2017).

Bone diagenesis is complex, depending on multiple factors which influence the rate of decomposition. Microstructural changes to bone can occur after few months, depending on the environmental conditions of the deposition (BELL *et al.* 1996). These factors are mainly pH (soil acidity), groundwater flow, organic activity and temperature, all of them interdependent.

The presence of water by itself is not detrimental to bone preservation. Waterlogging can promote bone and even soft tissue preservation (FIEDLER *et al.* 2009; HUISMAN *et al.* 2017). Even neutral or moderately acidic waters only slightly affect preservation (at least in the first year: CHRISTENSEN & MYERS, 2011), because anaerobic environments prevent microbial attack (JANS *et al.* 2004; POKINES & BAKER 2014). However, cycles of wetting and drying facilitate the dissolution of bone, since water absorbs nutrients until reaching a saturated solution; if water is continuously re-

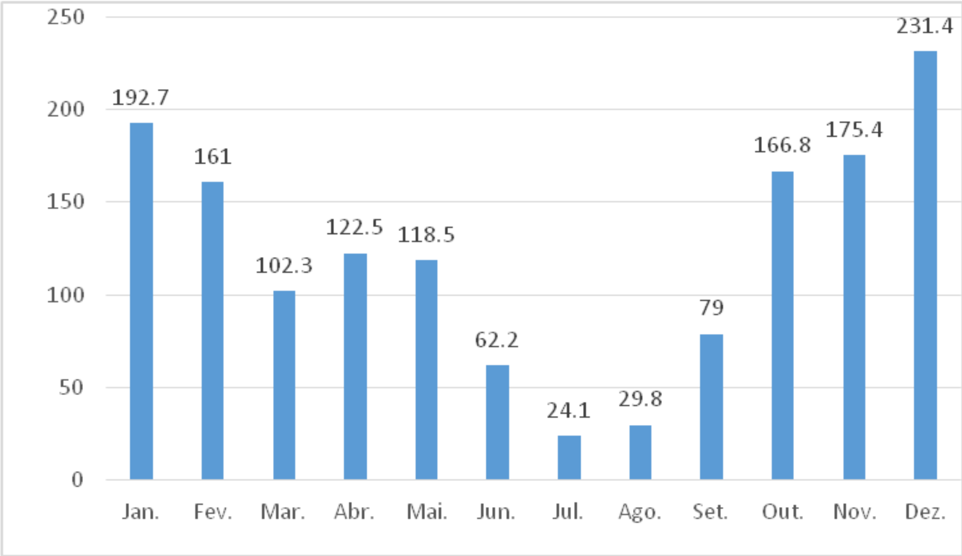


**Fig. 3.** Average monthly precipitation in mm for Braga (Portugal). Source: Climate Normals 1971- 2000 – Braga, Posto Agrário.

**Fig. 3.** Precipitação média mensal (mm) em Braga (Portugal). Fonte: Normais Climatológicas 1971-2000 - Braga, Posto Agrário.

placed, lixiviation of bone minerals is constantly repeated, increasing bone pore width (HEDGES & MILLARD 1995; TURNER-WALKER 2008; SURABIAN 2012; HUISMAN *et al.* 2017). Bone porosity and dissolution are also affected by microbiological activity (NIELSEN-MARSH & HEDGES 2000; SMITH *et al.* 2007). Microbial activity is enhanced in wetting and drying cycles, which increase the reproductive rhythm of these organisms (TURNER-WALKER 2008; SURABIAN 2012). Microorganisms, insects and the contraction or expansion of soil are influenced by temperature, another important factor for bone preservation (MANIFOLD 2012).

Bone preservation is related to pH in corrosive soils, diminishing as pH lowers. In alkaline soils other early taphonomic conditions are more relevant for bone dissolution (NIELSEN-MARSH *et al.* 2007; SMITH *et al.* 2007; LÓPEZ-COSTAS *et al.* 2016). Hydroxyapatite recrystallization and decomposition is favored by low soil pH (MANIFOLD 2012) and by the low nutrient levels in granitic soils, because organisms exploit the nutrients absent in the soil from bone apatite, where they abound (CROW 2008; FORBES 2008; LATHAM & MADONNA 2014).

The conditions of deposition are also of relevance and modulate the most important factors (soil pH, water flow, organic activity and temperature). Skeletal preservation in the *Via XVII* necropolis is generally very poor, despite the conditions of deposition. There is an exceptional case (I009), of an unlidded lead coffin (accompanied by a wood coffin and set in box of very large granite blocks) which shows the best preserved skeletal evidence in the sample, with the only identifiable bones and teeth that subsisted excavation (Figure 4). Lead coffins are typically associated with good bone preservation in inhumations (GRAY 1922; FLEURIOT & GIOT 1977; CHARLESWORTH 1978; BARBER *et al.* 1990; LUCY 2005; CLAPÉS SALMORAL *et al.* 2016) or even cremations (WHEELER 1929). Waldron and colleagues (1979) have shown lead usually does not transfer from the soil to bones; yet, in situations with particularly high lead concentrations, such as inhumations in lead coffins, lead from the soil contaminates bones (WALDRON 1981; MOLLESON *et al.* 1998). Lead then limits the action of bacteria, promoting bone preservation (MOLLESON *et al.* 1998). In this Braga sample, even the existence of a lead coffin did not prevent the dissolution of the majority of the inhumed skeleton. Lead coffins sometimes even promote soft tissue preservation (CELORIA 1966; ZIGAROVICH 2009), but when these coffins are not sealed, bone dissolution is likely to occur (TAYLOR 1993; POKINES & BAKER 2014). This was the case in *Via XVII*, since the lead coffin never had a lid and the massive granite box around it allowed water flow, as testified by the slight accumulation of low caliber sediment and by the bones floated out of anatomical connection.

The poor preservation of this sepulchral context was, however, differential. Some structures, like the lead coffin preserved skeletal evidence, while in other graves even the more resistant teeth (HOLLUND *et al.* 2015) were dissolved. According to the preservation frequencies of the necropolis of *Via XVII* (Table 3), the structures promoting skeletal preservation were box presence, the absence of sediment and the use of a gable roof cover. So, the ability of structural variables to diminish water flow or the contact of bone with sediment seem essential for the preservation of (at least some) osteological material. To test that hypothesis, graves which structure presumably avoided skeletal contact with soil or limited water flow were compared with the other graves. So, the skeletal preservation frequency of graves without sediment (100%) and covered with a brick/*tegulae* gable roof was compared with that of disturbed/unsealed graves without gable roofs (43.8%). As seen in Table 4, the frequencies are significantly different ($\chi^2$ = 7.910; p = 0.005).


**Fig. 4.** Inhumation grave I009 after removing most of the granite block lid and prior to excavation. Note skeletal elements are not discernible and sediment that seeped in the structure formed small blocks when dry (©UAUM).

**Fig. 4.** Sepultura de inumação I009 após remoção de parte dos blocos graníticos da sua cobertura, antes da escavação do esqueleto. De notar que os elementos esqueléticos não são discerníveis e que o sedimento que se infiltrou na estrutura criou blocos quando seco (©UAUM).

**Tab. 4.** Bone preservation according to limitations to water flow and contact with sediment and respective chi squared ($\chi^2$) test results.

**Tab. 4.**Preservação óssea de acordo com as limitações ao fluxo de água e ao contacto com sedimento e respetivos resultados do teste chi quadrado ($\chi$2).

| Sediment/Gable roof | % | k/n |
|---|---|---|
| **Sediment absence or gable roof presence** | 100% | 9/9 |
| **Sediment presence and no gable roof** | 43.8% | 7/16 |
| $\chi^2$ = 7.910 | p = 0.005* | |

% - Percentage of inhumations with preserved osteological material; k - Number of inhumation graves with preserved osteological material; n - Number of inhumation graves in sample; $\chi^2$ - Chi squared test result; p - Probability value; * - statistical significance ($p < 0.01$).

It is interesting to note that box presence is very relevant, since all of the graves with gable roofs and sediment absence are boxed. Yet, only half (six in twelve) of the boxed inhumation graves that were disturbed or unsealed (allowing sediment contact with the skeleton) and did not have gable roofs preserved some bone fragments. Therefore, the relevance of box presence is relative. While sealed and undisturbed boxed graves preserve osteological material, if these graves allow sediment to infiltrate, only in the presence of gable roofs can there be bone preservation. All graves with gable roofs allowed sediment to seep into their boxes, which suggests these grave covers were able to promote bone preservation, probably through dissipation of water flow away from the inhumation remains, despite bone contact with acidic sediment.

## 4. CONCLUSIONS

Late Imperial and paleochristian inhumation burials from the *Via XVII* necropolis outside *Bracara Augusta* show very poor bone preservation overall. Some of these graves were void of any human remains, while others preserved small shards of human bone and -- in the particular instance of a lead coffin -- some tooth crowns. This was expected, given the acidity of granitic soils and the dry/wet cycles of this Northwest Portuguese site.

This work focused on understanding the predominant factors in the preservation of bone in those cases where human remains were identified (although not always recoverable). The presence of a box could not facilitate preservation by itself. Yet, if the box was either sealed (without sediment infiltration) or covered with a gable roof, preservation was higher than expected. This result corroborates soil acidity and wetting/drying cycles as the primary elements in complete bone decomposition. Therefore, structures avoiding contact with sediment and/or flowing water are essential for bone preservation.

The diagenetic conditions of human inhumations in Northwest Portugal are detrimental for research in biological anthropology and archaeotanatology, especially in periods up to the Middle Ages. Further research on this region's diagenetic conditions affecting bone preservation in other sites and on different periods is of great interest. Such knowledge on the regional rates of bone decomposition will allow for better approach to bioarchaeological field work and maximize the potential of the laboratorial analysis of the remains.

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