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Caring for the dead, understanding the living: bioarchaeology of care in a 2nd–3rd century CE burial from Roman Malaca☆

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ABSTRACT

The discovery of a Roman burial dated to the 2nd–3rd centuries CE in the western necropolis of Malaca provides valuable insights into funerary practices and health in Roman Hispania. The burial, characterized by its well-arranged structure and diverse grave goods, is analyzed using an osteobiographical approach. Skeletal and funerary data reveal vertebral lesions indicative of a chronic condition, with possible infectious or degenerative origins. This study, employ an advanced methodological framework to explore, care practices, the impact of disease on quality of life, applied treatments, and their broader implications for health and social dynamics in Roman Málaga.

1. Introduction

The discovery of a well-preserved tomb in the western necropolis of *Malaca* (Málaga, Spain) provides an opportunity to examine aspects of life and death in this ancient Roman city. This study focuses on Tomb 6, located at 6–8 Rosarito Street, Málaga, analyzing human remains to investigate topics such as aging, medical care, social perceptions of disease and impairment, and funerary practices. By examining this case, we gain insight into the health challenges faced by individuals in Roman *Malaca*.

Malaca, located on the southern Iberian coast, was originally founded as a Phoenician settlement (*Malaka*) and flourished under Roman rule, becoming a prosperous municipality centered on maritime trade and fish processing (Mora Serrano and López Castro, 2002). This historical background provides essential context for understanding funerary practices during the Roman period.

This research contributes to the study of health and caregiving in provincial Roman contexts. The analysis of the individual interred in Tomb 6, an older adult from *Malaca*, offers valuable insights into care practices and the lived experience of aging in Roman society, expanding bioarchaeological research on impairment and medical care in antiquity.

2. Historical-archaeological context

Malaca, situated on the western edge of the Mediterranean See, occupied a large alluvial plain formed by the Guadalmedina River, was surrounded by mountains (Álvarez-Martí-Aguilar et al., 2022, p. 180). As the successor of the Phoenician city *MLK*, (*Malaka*), *Malaca* retained its Phoenician urban layout, as noted by Strabo in the 1st century CE.

Its status as a federated Roman city allowed it to preserve local economic activities, such as fish processing, while adopting Roman cultural elements, including funerary customs (Corrales Aguilar and Mora Serrano, 2005). Malaca's port became a central hub for Mediterranean trade, facilitating the movement of goods, such as olive oil, wine, and cereals, and connecting Baetica to the Empire (Corrales Aguilar and Mora Serrano, 2005, p. 18; Mora Serrano et al., 2023). During the 1st century CE, the city underwent significant urban reorganization and monumentalization, reinforcing its importance as a political, religious, and cultural center during the Republic-Empire transition (Corrales Aguilar and Corrales Aguilar, 2012, p. 374).

The city expanded on both sides of the Guadalmedina River, with burial spaces in use from the Phoenician-Punic period to Late Antiquity. The Western Necropolis, where Tomb 6 from Rosarito Street was found, served as a key funerary site for over 800 years. It evolved from cremation to inhumation, reflecting broader changes in social and political contexts, and providing a diachronic view of funerary practices (López-Chamizo, 2020) (Fig. 1).

The burial area on present-day Rosarito Street, part of the Western Necropolis, shows multiple phases of occupation. This necropolis was in use from the 6th century BCE to the 5th century CE, However, the coexistence of cremation and inhumation practices is documented from

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the 2nd century BCE to the 3rd century CE, reflecting the diversity of funerary customs in Roman Malaca. The location of Tomb 6 provides insights into how urban transformations influenced burial customs, health practices, and social memory in Roman Malaca. Located along Mármoles Street, the Western Necropolis, followed Roman urban planning, with funerary enclosures organized along roads (Mayorga Mayorga and Rambla Torralvo, 1997). This tomb, dating to the late 2nd and early 3rd centuries CE, reflects Malaca's prosperity and cultural diversity during that period.

3. Bioarchaeology of care: definition and relevance

The Bioarchaeology of Care is a theoretical and methodological framework that examines the presence of caregiving in past societies through osteological, archaeological, and contextual analyses (Tilley, 2015a,b). It emerged in response to the growing recognition that paleopathological studies should move beyond disease diagnosis and seek to understand the social responses to impairment and chronic conditions. This approach integrates biocultural and social perspectives, considering how individuals with physical limitations were treated within their communities.

By shifting the focus from individual pathology to the broader social implications of disability, analyzing whether individuals received assistance and how caregiving was structured within different sociocultural systems. By investigating skeletal markers of disease, associated mortuary practices, and broader historical contexts, this approach reconstructs the lived experiences of impaired individuals and their interactions with society (Schrenk and Tremblay, 2022).

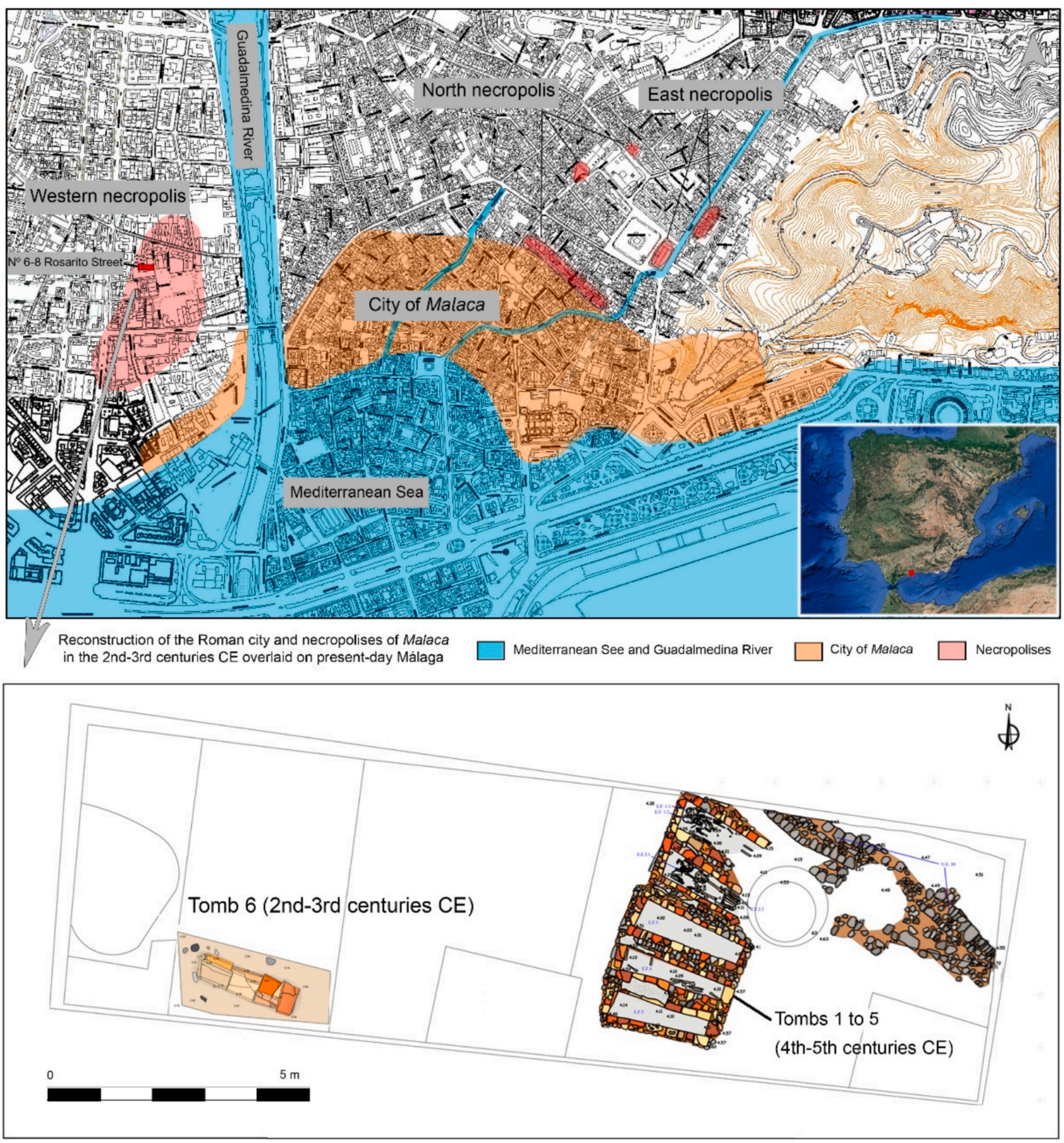

Fig. 1. Location. Roman city of *Malaca* (2nd–3rd centuries CE) overlaid onto present-day Málaga. Burial areas (in red) indicate the locations of the main necropolises. The lower plan details the excavation area, highlighting Tomb 6 (2nd–3rd centuries CE) and Late Antique burials (4th–5th centuries CE).

One of the most significant contributions of this framework is the Index of Care, a structured model designed to evaluate the presence, nature, and implications of caregiving in archaeological contexts (Tilley, 2015a,b, Tilley and Cameron, 2014). This model provides a systematic way to determine whether an individual with physical impairments could have survived without assistance, and if so, what type of support they might have received. Recent applications of this methodology have demonstrated its relevance across diverse cultural and temporal contexts, ranging from prehistoric hunter-gatherers (Tilley, L., & Cave and Oxenham, 2016; Tilley, 2015a,b) to institutionalized populations in the 19th and 20th centuries.

In Roman contexts, while direct applications of the Index of Care remain scarce (Navarro et al. 2017; Caldarini et al., 2015), historical and archaeological evidence suggests the existence of well-developed healthcare systems, including military *valetudinaria*, domestic medicine, and public infrastructure aimed at assisting individuals with impairments. The presence of medical tools, inscriptions related to caregiving, and references in Roman literature further reinforce the idea that social responses to disease and disability were complex and varied depending on class, gender, and status.

3.1. The Index of care and its application in bioarchaeology

The *Index of Care* is a structured methodological tool designed to assess past caregiving practices through osteological and contextual evidence. Developed by Tilley (2011, 2015a,b), https://www.indexofcare.org; (Tilley and Cameron, 2014), this model systematically evaluates whether individuals with impairments could have survived without external assistance, the nature of the care they might have received, and its broader implications within their communities.

The Index of Care will be used to assess the individual's health status and reconstruct the potential caregiving strategies employed within the Roman community of Malaca. This will involve:

- Analyze osteological markers of pathology to determine the degree of physical limitation.
- Evaluate mortuary treatment to infer whether burial practices indicate special care or social recognition.
- Contextualize the findings within historical evidence of medical and social assistance in the Roman world.

By applying this framework, this study seeks to provide a more nuanced understanding of health-related care in ancient Rome, considering both biological and cultural factors in shaping individual experiences of disease and impairment.

The study of disability and aging in the past has increasingly incorporated perspectives that go beyond paleopathological diagnosis, exploring the interaction between the biological body, social identity, and community responses. In this sense, integrating approaches such as social vulnerability, osteobiography, and funerary materiality facilitates the assessment of the health status of the individual from Tomb 6 and the forms of support they may have received in life. Additionally, it expands the understanding of the social and cultural dynamics that influenced their funerary treatment.

3.2. Beyond the index of care: aging, disability, and social identity

Beyond the *Index of Care*, a broader theoretical perspective is required to fully interpret the implications of health, impairment, and aging. The concept of social vulnerability (Fineman, 2010) highlights how societal structures influence an individual's access to resources, care, and social recognition. In past societies, factors such as gender, age, and economic status played a crucial role in shaping caregiving networks and determining whether an individual would receive assistance or be marginalized.

The theory of embodiment (Csordas, 1994; Sofaer, 2006a,b) provides another essential framework, emphasizing that social experiences are physically inscribed onto the body. Skeletal markers of disease, trauma, and stress can thus be interpreted not only as biological conditions but also as reflections of lived experiences, including care, neglect, and social belonging (Hosek and Robb, 2019a,b).

Additionally, the concept of identity and personhood in bioarchaeology (Knudson and Stojanowski, 2008) allows us to explore how individuals were socially constructed through their physical and cultural attributes. This perspective is particularly relevant in funerary archaeology, where the treatment of the deceased provides insight into how they were perceived by their community.

By integrating these perspectives, this study explores how care, health, and impairment were experienced in Roman Malaca, considering both biological and cultural dimensions.

3.3. Aging, disability, and funerary materiality in Roman contexts

The study of aging and disability in antiquity has evolved beyond purely medicalized interpretations, incorporating cultural and biographical approaches (Gilchrist, 2004; Gowland and Thompson, 2013).

In Roman society, old age was often associated with wisdom and experience, yet physical decline could lead to social exclusion or dependency (Parkin, 2004). The role of caregiving, whether within the household or through broader communal structures, reflects complex negotiations of value, reciprocity, and obligation.

Material culture plays a key role in signaling care and recognition. The biography of objects (Kopytoff, 1986) suggests that grave goods can be analyzed not just as material possessions, but as representations of identity, memory, and social relationships. Likewise, studies on mortuary ritual and emotion (Tarlow, 2006) emphasize the role of funerary practices in shaping the legacy of individuals after death.

By incorporating these perspectives, this study seeks to contextualize the individual buried in Tomb 6 within the broader framework of health, social identity, and caregiving in the Roman world. The application of the Bioarchaeology of Care combined with these theoretical approaches enables a more comprehensive interpretation of how disability, aging, and funerary treatment intersected in ancient *Malaca*.

4. Materials and methods

The data for this study come from the analysis of Tomb 6, uncovered during a salvage archaeological excavation at 6–8 Rosarito St., Málaga Spain. The excavation followed rigorous stratigraphic and taphonomic documentation (López-Chamizo, 2011).

In the laboratory, a multidisciplinary analysis of artifacts and human remains was conducted, including cultural and ritual context studies, as well as osteological and radiographic analysis to assess health, age, sex, and pathology. Carbon-14 dating and DNA analysis were used to determine the chronology and explore genetic ancestry, providing data for interpreting the individual's burial practices and life history.

Osteological markers helped assess factors like sex, age, stature, diet, pathologies, and occupational stress, revealing health issues such as degenerative joint disease and nutritional deficiencies.

To estimate age, various methods were applied to different regions of the skeleton, including the pelvis, ribs, skull, and cartilage. Given the well-established recommendation in osteology to avoid relying on a single skeletal element for age estimation, a multi-method approach was employed to enhance accuracy and account for intraindividual variability in skeletal aging. Cranial suture obliteration was assessed (Meindl and Lovejoy, 1985; Olivier, 1960), and rib ends were analyzed using a combination of techniques (Cerezo-Román and Espinoza, 2014; DiGangi et al., 2009; Dudar, 1993; Garamendi et al., 2007; Hartnett, 2010; Kunos et al., 1999; Loth, 1989; Oettle and Steyn, 2000; Yaşar İşcan et al., 1984; Yoder et al., 2001). Thyroid and hyoid cartilage ossification was evaluated using methods by Cerny (1983), Dang-Tran et al. (2010), Garvin (2008), and Vlcek (1980), along with analysis of clavicle sternal ends (Szilvássy, 1988). The integration of multiple methods allowed for cross-validation of results, reducing potential biases associated with differential skeletal preservation and variation in age-related changes across anatomical structures.

The pubic symphysis was analyzed following methods by Brooks and Suchey (1990), Buikstra and Ubelaker (1994), as well as additional considerations from Lovejoy et al. (1997). The auricular surface of the ilium was assessed (Buckberry and Chamberlain, 2002; Igarashi et al., 2005; Lamb, 2024; Lovejoy et al., 1985).

Sex estimation was conducted using various osteological methods focused on the combined morphological features of the pelvis, cranium, and long bones. The pelvic morphology was analyzed following Phenice's criteria (1969), focusing on the greater sciatic notch and preauricular sulcus (Bass, 1978; Buikstra and Ubelaker, 1994; Ferembach et al., 1980; Krogman and Iscan, 1986; Rösing et al., 2007). Bruzek's method (2002) was systematically applied to assess five pelvic variables with a 95 % accuracy rate and a 2 % margin of error.

Cranial traits assessed included the nuchal crest, mastoid process, supraorbital margin, glabella prominence, and mental eminence (Acsádi and Nemeskéri, 1970; Buikstra and Ubelaker, 1994). The long bone and dental metrics were also evaluated for sex estimation using regression formulas and comparative data tables (Alemán Aguilera, 1997; Alemán Aguilera et al., 2010).

Health indicators were examined through the identification of various pathologies, including congenital, degenerative, infectious, traumatic, and metabolic anomalies, as well as stress-related conditions influenced by environmental factors. Each condition was evaluated based on factors like sex, age, mode of disease acquisition, and its effect on the individual's life. In Tomb 6, infectious pathologies, especially those related to epidemic outbreaks, were particularly significant, likely influencing the individual's health and life course (Aufderheide et al., 1998; Boros-Major et al., 2011; Brickley and Ives, 2008; Campillo, 2001; Cohen et al., 2013; Crandall and Klaus, 2014; D'Anastasio et al., 2011; Dutour, 2022; Grauer, 2012, 2023; Ortner, 2003; Pinhasi and Mays, 2008; Roberts and Buikstra, 2003). For the assessment of dental pathologies, a detailed macroscopic analysis was conducted to identify conditions such as caries, periodontal disease, abscesses, and antemortem tooth loss. Enamel hypoplasia (EH) was evaluated through visual inspection of linear defects on the enamel surface, following the criteria established by Goodman and Rose (1991). Additionally, the methods of Reid and Dean (2005) were applied to estimate the chronology of EH formation by measuring the distance of defects from the cementoenamel junction and correlating it with enamel formation timelines for each tooth type. This combined approach provided a precise assessment of dental health and physiological stress episodes experienced during the individual's development.

The funerary context was analyzed by documenting the extent of the necropolis, burial rituals, and taphonomic processes, examining grave goods, body positioning, and mortuary treatments. Taphonomic analysis focused on decomposition patterns, signs of reuse, looting, and the burial site's current state (Duday et al., 1990, 2014).

5. Archaeological analysis of the context

5.1. Funerary and spatial characteristics

Tomb 6, is located to the west of the highimperial necropolis, in an area with no evidence of other contemporary graves. It is oriented from east to west with a slight inclination towards the southeast, situated in a less densely occupied section of the necropolis during the highimperial period.

Externally, funerary structure n° 6 preserves remains of a masonry covering structure, resting on a thick layer of terrestrial sediment. The tomb was covered by a double-pitched tile system, with a tile marking the head and a triangular brick piece at the feet. The lower part of the tomb was excavated into geological layers with an elongated shape, rounded ends, and a small internal step, showing no wall treatment (Fig. 3).

The skeletal remains were found in a supine position, with arms placed along the body and legs extended. The burial is accompanied by a complex set of grave goods, including four lamps, four glass pieces, three *accus crinalis*, a ceramic plaque, a shell, a ceramic mortar, and a jug. (Fig. 2). Numerous small, headless nails were documented along the sides of the burial pit, positioned equidistantly, and found above, beneath, and beside the grave goods and skeletal remains (Fig. 3C). Additionally, three larger nails with heads were identified: one near the upper part of the burial by the parietal bones, another aligned with the thoracic area near the heart, and the third positioned near the feet. Numerous crystal nodules were also documented along the body, deposited from the neck to the knees. The fragments, measuring between 2–4 mm. Next to the right knee, a rectangular cluster measuring approximately 5 cm long by 2 cm wide was found, containing fragments of various shapes and sizes (Fig. 5T.).

Next to the skull, three *accus crinalis* (Fig. 4B) with a spherical proximal end, classified as Beal XX 7 type and dated between the 1st and the 5th century CE were found (Beal, 1983, p. 189 Pl. XXXIV-XXXV). A Dressel-28 type lamp (Fig. 4C), with a smooth surface and a molded margin separating the disc, was documented near the face. Another Dressel 28 lamp (Fig. 4D) with vine leaves and grape clusters decoration on the margin was found, as well as a metal tack associated with the coffin cover on the right clavicle (Fig. 4E). In the upper third of the skeleton, over the left thoracic cavity, a large metal nail (Fig. 4F) and two stones were found embedded on either side of the neck. A completely fragmented Dressel 28 lamp was documented near the left hip (Fig. 4H). Each hand held a glass vessel: an Isings 102 type bottle (Fig. 4G) in the left hand and an Isings 68-type bottle form in the right (Fig. 4P). Next to them, an Isings 82 unguentarium (Fig. 4O) and another Isings 102 (Fig. 4N) bottle were placed.

On the left patella, two pieces were arranged: an *acanthocardia aculeata* shell (Fig. 4I) and a fragmented ceramic plaque (Fig. 4J). In the lower part of the tomb, a ceramic jug made of common ceramic (Fig. 4K), possibly of Syrian-Palestinian, Cypriot, or Anatolian coast production (Bernal Casasola et al., 2011; Bernal-Casasola 2019, p. 645-646), was documented. Next to it, a Dressel 28 lamp (Fig. 4M) with vine leaves and grape clusters decoration and a modified orificium was found. Along with these two pieces, two large nails not related to the coffin's construction were found (Fig. 4L).

On top of the coffin, a set of two lamps, a yellowish clay nodule, and a nail were placed. The first lamp corresponds to a Dressel 28 (Fig. 4Q) type with an inscription on the margin of the piece: P R R O, and on the other side, O P F. The second lamp is a Dressel 28 (Fig. 4R) type with grape cluster decorations on the margin and an erotic scene on the disc, dating to the second half of the 2nd–3rd century CE. To the left, a bowl with a curved edge type 2, featuring the characteristic striated pouring spout of form 7 and the perforations of type 6, made of African common ceramic type 6–7 of Bonifay form Utiza 5 (Bonifay, 2004, p. 249), was placed (Fig. 4A). In the lower part of the tomb, next to the tile marking the western closure, an animal bone diaphysis with possible signs of reddening was found.

Radiocarbon dating using the InCal 20 calibration curve places the tomb between 126–232 CE (1865 ± 20 BP, PSUAMS-9811). Ancestry analysis of the individual (Genetic Identifier: I26172) reveals genetic contributions from Iron Age Iberia, Roman-Byzantine Anatolia, and North African Punic populations (Carrión et al., 2024).

5.2. Funerary practices, grave goods, and ritual significance.

Although the external structure of the burial appears relatively simple, the presence of diverse grave goods—including lamps, glass vessels, and nails—suggests ritualized funerary practices. These objects may have held symbolic, practical, or protective functions within the broader framework of Roman funerary traditions, potentially reflecting

Fig. 2. Tomb 6. Funerary Artifacts and Spatial Distribution. Central view: an overhead perspective of the burial. Detailed close-ups highlight the placement of grave goods in relation to the skeletal remains.

aspect of social identity and memory preservation through death.

The Western Necropolis of Malaca, a major burial site, exhibits a diversity of funerary customs, ranging from simple inhumations to more elaborate monumental structures, indicative of social stratification. Its prolonged use, spanning from the Phoenician-Punic period to Late Antiquity, reflects an ongoing evolution of burial practices, shaped by both local traditions and external influences. By the 2nd century CE, significant reorganization of the necropolis is evident, including the addition of pathways, walled enclosures, and structures for funerary rituals, suggesting a more structured and regulated approach to burial practices (López-Chamizo, 2020).

The grave goods in the tomb are consistent with those typically found in the necropolis, such as glass objects, ceramics, lamps, and metal elements (Mayorga Mayorga and Rambla Torralvo, 1997). However, the presence of unique elements, including crystal adornments and personal care items, suggests a more elaborate ritual. The placement of objects both inside and outside the coffin indicates a combination of personal ritualistic, and possibly apotropaic practices, as observed in other Roman funerary contexts (Alfayé Villa and Sánchez Natalías, 2020). The inclusion of similar objects in simpler burials, yet with variations in quality, highlights social distinctions in funerary customs and individual commemoration (Sevilla Conde, 2014, pp 214–217).

The available archaeological context does not allow for a definitive determination of whether the tomb was part of a *lucus sepulturae* or an independent monument. The modest structure of the burial contrasts with the richness of grave goods, suggesting cultural significance comparable to other regional necropolises, such as Baelo Claudia, where small monuments are often associated with *betyls* and aniconic stelae, preserving earlier ritual traditions (Vaquerizo Gil, 2023). The presence of the triangular piece at the base may reflect an intentional effort to integrate these older practices into the evolving funerary landscape. Notably, a similar triangular element has been documented in a necropolis dated to the 2nd–1st centuries BCE in Málaga, suggesting a possible continuities or reinterpretations of earlier funerary customs (López-Chamizo, 2020).

The careful treatment of the individual's body and the arrangement of grave goods suggest a society that placed significant value on ancestral memory and ritual beliefs. The spatial distribution of lamps, glass vessels, and nails suggests deliberate positioning linked to protection, purification, and guidance.

The constructive system surrounding the body, consisting of three distinct layers—the layer of stone, the tegulae covering, and the wooden coffin—demonstrates a deliberate effort to protect and structure the burial space. Among the grave goods, objects associated with personal care—such as *accus crinalis*, unguentaria, and a ceramic plaque with an uncertain function—align with Roman funerary traditions in which the *mundus muliebris* played a role in burial practices (Shumka, 2008). While the precise function of these objects in the funerary context remains uncertain, they may reflect practices of self-care and identity maintenance in life, serving as symbolic markers of social roles in death. Their deliberate inclusion suggests an effort to perpetuate aspects of the individual's memory within Roman conceptions of funerary commemoration and the afterlife.

This funerary arrangement suggests the use of ritual elements intended to ensure a safe passage to the afterlife, aligning with broader Mediterranean traditions in which specific grave goods and burial treatments reinforced connections between the living and the dead (Hope, 2009, p 118-125). In the Roman world, personal appearance and bodily care were central to social identity and status, concepts that extended into funerary practices, where objects associated with grooming and adornment could signify remembrance, honor, and social standing beyond death (Gardner, 1995, p. 380).

The microspatial analysis of the 3 cm long headless tacks suggests their association with an organic structure, likely a wooden coffin. Their equidistant arrangement indicates a systematic placement, possibly corresponding to the width of planks used in its construction. If this interpretation is correct, the coffińs cover and base would have composed of three longitudinal planks.

The grave goods can be divided into two main categories. The first group includes the mortar, glass vessels, and a possible makeup plate,

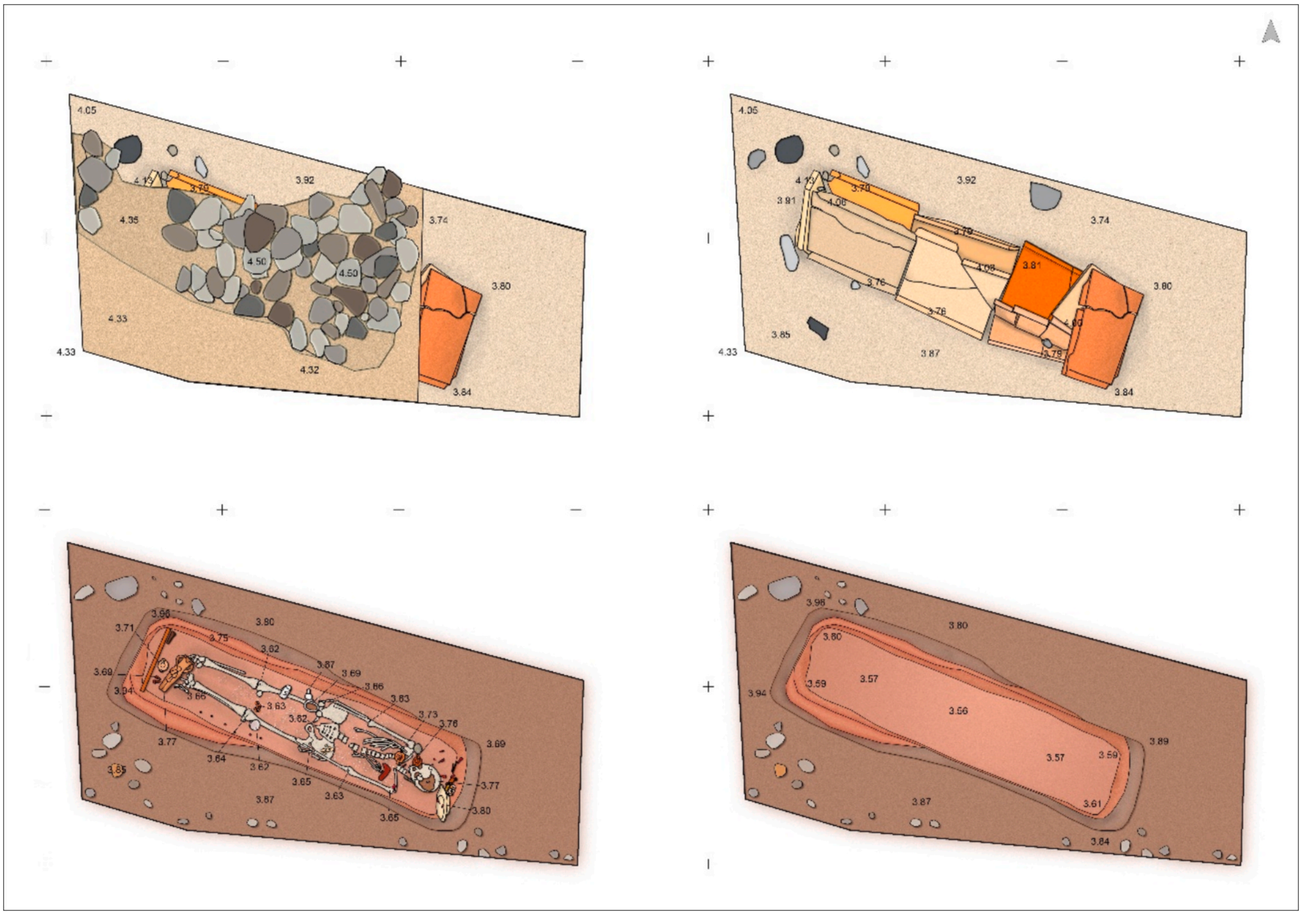

Fig. 3. Tomb 6. Plan views illustrating different construction and stratigraphic phases of the tomb. Top left: Uppermost layer, showing the external stone covering. Top right: Tegulae and brick arrangement forming the tomb's structure. Bottom left: Skeletal remains and grave goods distribution within the burial. Bottom right: Excavation of the burial pit, revealing the carved geological layer.

suggesting an association with cosmetic preparation and personal care. These items aling with the concept of *mundus muliebris,* commonly associated with Roman womeńs domestic and social identity, reflecting aspects of the deceasedś status an role life (Shumka, 2008, p. 178). The crystals found throughout the burial sediment, particularly near the knees, may have been originally attached to a garment, indicating a deliberate decorative arrangement.

The second group includes lamps, nails, and a shell, all strategically placed within the tomb. The lamps likely held magical symbolism, with the number six having particular significance in Eastern religious beliefs, aside from their practical role as light sources, as evidenced in magical texts and Greco-Roman numerology (Oroz Reta, 1975, pp. 447). The shell, commonly found in tombs, symbolized femininity and served as an apotropaic object, further reinforcing the deceased's gendered identity (Sevilla Conde, 2014, p. 224, Oliver Fox, 1996, p. 301–302, Eliade, 1952, 164, Reece, 1993).

The iron nails may have functioned as protective talismans, positioned in response to perceived ailments. Literary sources document their use as magical-therapeutic remedies to "fix" the dead and diseases, a concept referenced in ancient texts such as Pseudo-Quintilian's *Declamationes Maiores* and the *Clavus Annalis* ritual, originally linked to collectives calamities. Similarly, Pliny the Elder (*Nat. Hist.* 28, 63) describes the practice of driving an iron nail into the ground at the site where a person suffering from epilepsy first collapsed, as a means of neutralizing the illness. This suggests a broader cultural framework where nails, due to their metal composition, were considered active agents in healing and protective rites (Alfayé Villa, 2010, 2014). In tombs across the Iberian Peninsula, particularly in Valencia, nails have been associated with burials of individuals suffering from tuberculosis or malnutrition, suggesting a link between these objects and the lived experience of illness (García Prósper, 2015).

The origin of certain items, such as the ceramic jug possibly originating from the Syrian-Palestinian region, Cyprus, or the Anatolian coast, along with the African common ware bowl of Bonifay form Utiza 5, highlight *Malaca*'s extensive commercial connections with the Eastern and Southern Mediterranean. These links not only represent trade but also a shared cultural horizon that influenced local funerary practices. *Malaca*'s role in broader Mediterranean networks is further illustrated by a mid-2nd century CE Greek inscription (CIL II 251) documenting a guild of Syrian garum traders, showing how external interactions shaped the city's social and economic landscape (Ortiz Córdoba, 2021).

6. Osteobiographical analysis and index of care

6.1. Osteological analysis and pathological findings

The osteological analysis, combined with genetic analysis, confirms that the individual was genetically female (Carrión et al., 2024), estimated to be over 60 years old.

The dental analysis reveals significant oral health issues, including the loss and resorption of the maxillary right second molar (FDI 17), maxillary right third molar (FDI 18), and mandibular left first molar (FDI 37), as well as a carious lesion in the mandibular right first premolar (FDI 45). Malocclusion was observed in the mandibular central and lateral incisors (FDI 42, 41, 31, 32), accompanied by periodontal

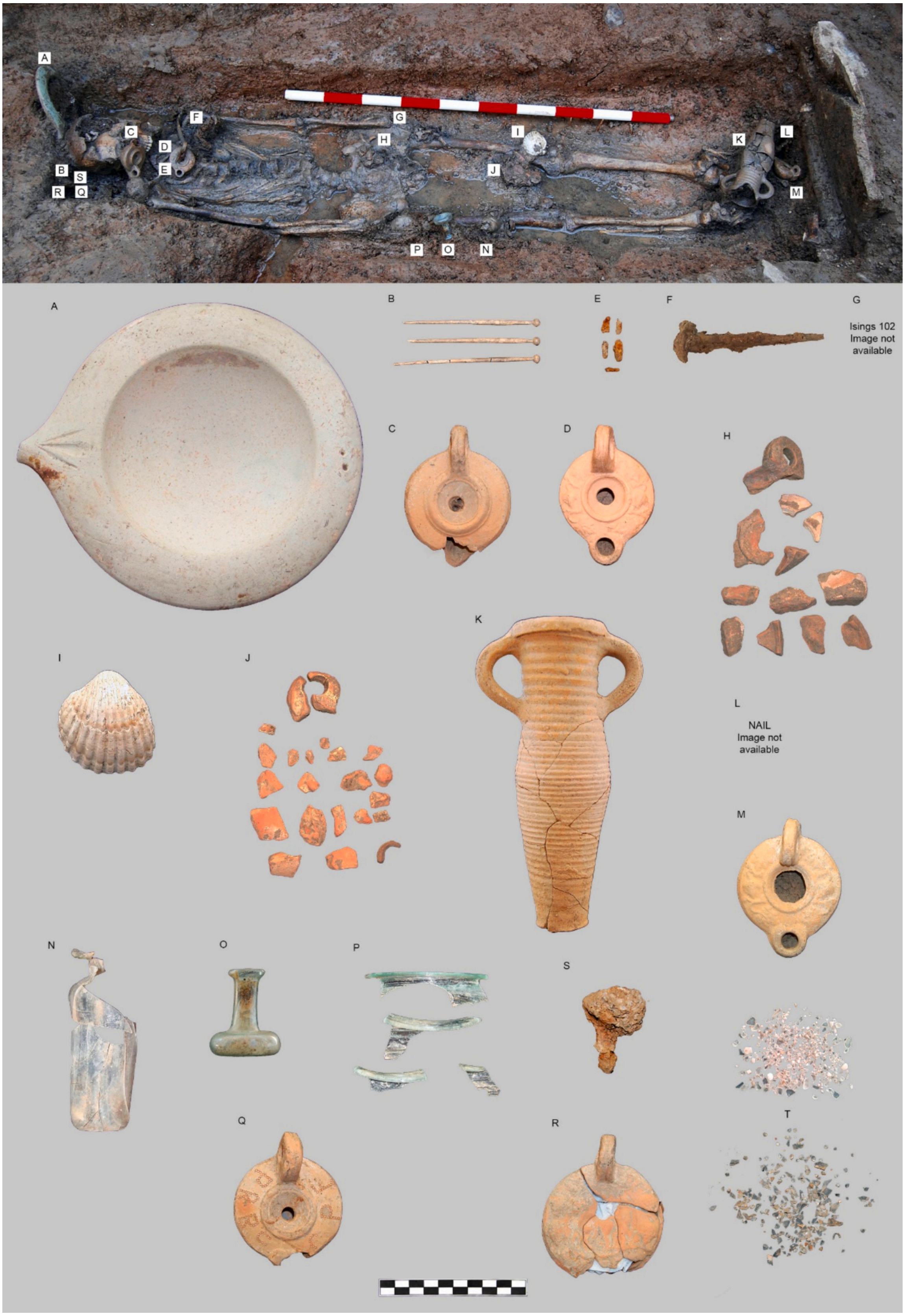

Fig. 4. Funerary artifacts. A: Bowl, Utiza 5 type (Bonifay); B: *accus crinalis*, Beal XX 7 type; C-D-H-M-Q-R: Dressel 28 type lamps; E: Coffin nails; F-L-S: Apotropaic Nails; I: *Acanthocardia aculeata,* Shell; J: Fragmented ceramic plaque; K: Eastern Mediterranean ceramic jug; G-N: Glass bottles, Isings 102 type; O: Glass unguentarium, Isings 82 type; P: Glass bottle, Isings 68 type; T: Crystal nodules.

Fig. 5. Different views of the skull and hip bone, pubic simphysis.

disease, characterized by root exposure up to 4 mm. Additionally, enamel hypoplasia with distinct growth lines was detected (Fig. 6).

The skeleton exhibits multiple pathological alterations. The sternum presents fragmentation of the manubrium, porotic activity and osteophytes at the junction between the clavicular and first costal notches, along with cortical loss. The ribs exhibit fragmentation, with cortical loss and evidence of edge remodeling. The humeri present mild osteoarthritic changes, exostosis in the bicipital groove, and porosity in the heads. The vertebral column displays thoracic scoliosis (Fig. 7) with facet joint involvement and exostotic reactions, primarily in the thoracic spine. The cervical vertebrae exhibits asymmetry and wedge-shapes deformities, while the thoracic vertebrae present wedge-shapes alterations, along with porosity and sclerosis. The lower lumbar vertebrae (L4 and L5) present evidence of epiphysitis in the right anterolateral region, selective remodeled sclerosis, decreased intervertebral space,

Fig. 6. Dental health and pathology. The images show dental wear, tooth loss, carious lesions (right image), malocclusion (bottom left), periodontal disease, and enamel hypoplasia (top left image) observed in the individual from Tomb 6.

(Fig. 9, Fig. 10). Schmorl's nodules are specifically observed in T8, T9, and L2. The sacrum shows incomplete fusion of the transverse crests, osteophytes on the wings and articular surfaces, sclerosis on the auricular surface, and sacroiliitis affecting the sacroiliac joint. The coxal bones exhibit porosity and osteophytes in the acetabular rim and sacroiliac articulation. The right femur exhibits localized trabecular porosity, cortical irregularities and exostosis on the femoral head, along with generalized surface porosity (Fig. 8). Mild osteoarthritic changes are also noted in the olecranon and various phalanges of the hands. Overall, the skeleton does not show pronounced muscle insertions. However, the bicipital groove of both humeri shows deepening and accentuation (a detailed descriptions of pathological alterations can be found in Tables 1 and 2).

6.2. *Application of index of care*

Step 1: Functional implications and differential diagnosis

The interpretation of the skeletal pathologies from Tomb 6 requires a structured and multidisciplinary approach. Differential diagnosis is essential to assess the interplay between mechanical stress, infectious diseases, degenerative changes, and metabolic deficiencies. Given the complexity of the observed lesions, a systematic comparison of potential conditions is necessary to refine the interpretation and avoid diagnostic bias (Waldron, 2009; Ortner, 2003) (Table 3).

The skeletal remains exhibit a series of structural and degenerative alterations, including dorsal scoliosis with facet joint involvement and exostotic reactions, which suggest a congenital or idiopathic origin (Aufderheide et al., 1998). This condition likely contributed to mechanical stress, promoting asymmetric vertebral wear and instability (Bridges, 1992). Additionally, spondylolisthesis and osteoarthritis are evident in the vertebrae, ribs, and sacroiliac joints, indicating long-term biomechanical strain (Rogers, 2012) (Fig. 11).

The skeletal remains also present indications of infectious and inflammatory processes, manifesting as vertebral osteitis with sclerosis, sacroiliitis, and focal cortical irregularities, which are commonly associated with chronic inflammatory or infectious conditions (Ortner, 2003). The observed alterations in L4 and L5 exhibit features that could be suggestive of a Pedro Pons sign, a hallmark of brucellar spondylitis (Bolaños Toro et al., 2022a,b; Etxebarría, 1996; Pons, 1929). This infection typically affects the lumbar, thoracic, and sacroiliac joints,

Fig. 7. Upper left: Lateral view of the lumbar spine showing scoliosis-related curvature. Upper right: Superior views of thoracic vertebrae with exostosis on the articular facets. Lower: In situ image of the skeleton on burial, illustrating spinal asymmetry and misalignment. Vertebrae were assembled based on their articulations, accurately reflecting the pathological deformation.

causing alternating phases of bone destruction and regeneration (D'Anastasio et al., 2011). However, similar features are also present in vertebral tuberculosis and chronic degenerative conditions, making a definitive diagnosis complex (Pappas et al., 2006; Weston, 2008) (Fig. 12).

Metabolic and nutritional stress is evidenced by cribra femoralis in the right femur and enamel hypoplasia, both indicative of early-life physiological challenges. Enamel hypoplasia suggests episodes of malnutrition or poor nutrient absorption during childhood (31–38 months), likely associated with weaning stress (Armelagos et al., 2009). These periods of nutritional deficiency and physiological stress could have weakened the immune system, increasing susceptibility to systemic conditions and potentially contributing to cribra femoralis and later degenerative changes (Walker et al., 2009; Oxenham and Cavill, 2010).

Cribra femoralis is often linked to anemia, metabolic deficiencies (iron or magnesium), or chronic infections such as tuberculosis (Miquel Feucht et al., 1999). While these indicators do not independently determine a primary pathology, they suggest an increased vulnerability to systemic diseases, which may have influenced overall skeletal health (Armelagos et al., 2009; Weston, 2008; Roberts and Manchester, 2010).

Dental pathologies further contribute to the understanding of systemic health. The presence of periodontal disease, caries, and enamel hypoplasia suggests chronic oral inflammation influenced by dietary habits, general health status, and metabolic stress during development

Fig. 8. Right femoral head with trabecular porosity and cortical irregularities.

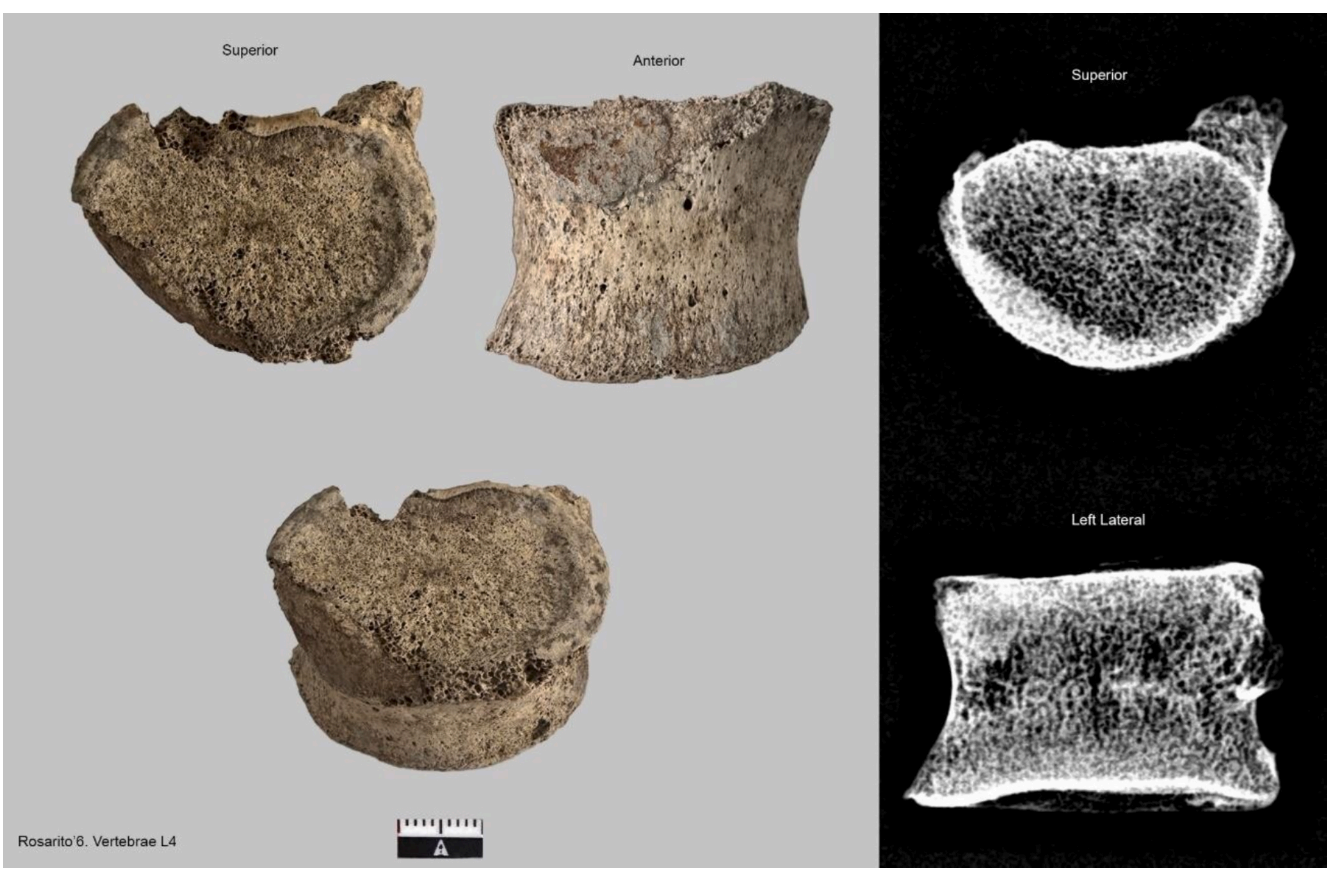

Fig. 9. Vertebrae L4. Macroscopic and radiographic views of the fourth lumbar vertebra (L4). The left panel displays superior, anterior, and lateral views, showing extensive porosity, cortical thinning, and areas of irregular bone formation. The right panel presents radiographic images in superior and lateral projections, highlighting trabecular bone loss, cortical resorption, and dense sclerotic remodeling in the affected regions. These alterations are consistent with chronic infectious and degenerative processes.

Fig. 10. Vertebrae L5. Macroscopic and radiographic views of the fourth lumbar vertebra (L5). The left panel displays superior, anterior, and lateral views, showing extensive porosity, cortical thinning, and areas of irregular bone formation. The right panel presents radiographic images in superior and lateral projections, highlighting trabecular bone loss, cortical resorption, and dense sclerotic remodeling in the affected regions. These alterations are consistent with chronic infectious and degenerative processes.

(Lukacs, 2012; Humphrey et al., 2014). Periodontal disease is primarily associated with poor oral hygiene but has also been linked to systemic inflammatory responses. Caries, on the other hand, are more closely related to carbohydrate consumption rather than direct nutritional deficiencies (Humphrey et al., 2014).

Although these findings provide valuable insight into overall health, they do not serve as primary diagnostic markers for the observed skeletal pathologies. Instead, they complement the broader picture of metabolic and systemic challenges that may have shaped the individual's life course.

A comparative analysis was performed to assess the plausibility of various conditions:

- Brucellosis: The presence of vertebral sclerosis and sacroiliitis aligns with patterns seen in brucellar spondylitis; however, these features are not exclusive to this condition. The absence of vertebral collapse differentiates it from classical tuberculosis, but further analyses are needed to determine whether the observed lesions align fully with infectious spondylodiscitis (Pappas et al., 2006; Bolaños Toro et al., 2022a,b).
- Vertebral Tuberculosis: Some radiological similarities exist; however, the lack of significant vertebral destruction, large abscesses, or extensive vertebral collapse reduces its likelihood. Nonetheless, an atypical presentation cannot be entirely ruled out (Weston, 2008; Roberts and Manchester, 2010).
- Osteoarthritis: The degenerative changes observed are consistent with chronic mechanical wear and aging-related alterations. However, they do not fully explain the cortical porosity and cavitations in the lumbar vertebrae, suggesting additional pathological processes (Waldron, 2009).
- Ankylosing Spondylitis (AS): The absence of syndesmophytes, characteristic vertebral fusion, and symmetrical sacroiliitis makes AS an unlikely diagnosis. Additionally, the asymmetric nature of sacroiliac involvement does not align with classic AS progression (Ortner, 2003).
- Scoliosis: Likely a significant contributor to vertebral instability, scoliosis may have exacerbated degenerative changes and influenced stress distribution in the spine. However, its presence does not fully account for the observed cortical porosity and inflammatory alterations (Rogers, 2012).
- Spondylolisthesis: Considered due to indicators of mechanical instability, but the lack of clear vertebral displacement makes it difficult to confirm definitively. It remains a possible factor contributing to spinal stress (Aufderheide and Rodríguez-Martín, 1998).
- Dental Pathologies: Periodontal disease and enamel hypoplasia provide insight into systemic stress and nutritional deficiencies. While these conditions may have influenced skeletal health, they are secondary to the broader degenerative and infectious processes under evaluation (Lukacs, 2012).

The skeletal alterations suggest a multifactorial etiology involving mechanical, infectious, degenerative, and metabolic factors. Rather than pointing to a single definitive pathology, the combination of lesions reflects a complex interaction of chronic stressors impacting skeletal integrity. Chronic infection remains a plausible component, but the

Table 1
Analysis of skeletal remans.

Sternum	Macroscopic: Fragmentation manubrium with porotic activity. Osteophyte formation at the junction of the clavicular and first costal notch. Partial resorption of the internal cortical bone in some areas. Radiological: White areas in the costal and clavicular support zones, enlarged trabeculae in some areas.
Ribs	Macroscopic: Fragmentation with cortical bone loss in some areas. Possible remodeling activity at the edges. Radiological: Normal trabeculae with some white spots, sclerosis on the vertebral edge where they articulate with the vertebrae.
Humerus	Macroscopic: Exostotic formation alongthe bicipital groove. Porosity on the humeral head. Radiological: Sclerotic changes along the bicipital groove, with increased trabecular density in the humeral head and coarser trabeculae in the diaphysis. A radiopaque linear band is visible along the lateral epicondyle, condyle, and supracondylar crest. A sclerotic margin is present on the anatomical neck.
Coxal	Macroscopic: Porosity activity and osteophyte formation along the acetabular rim. The sacroiliac joint exhibits marginalosteophytes and trabecular rarefaction. Radiological: White areas on the acetabulum, iliac spine, sciatic notch, and ischial tuberosity with sclerosis. Large and small trabeculae in areas with possible cavitation.
Sacrum	Macroscopic: Incomplete fusion process of the transverse sacral crests, with marginal osteophyte formation along the sacral wings and articular surfaces. Radiological: Sclerosis on the auricular surface and the edge of S1. Large and small trabeculae with areas of cavitation inside, indicating high bone activity.
Femur	Macroscopic: Porotic lesions possibly consistent with cribra femoralis on the femoral neck, an exostotic rim on the femoral head, and generalized surface porosity. Radiological: Two sclerotic white lines along the femur, dense trabeculae in the femoral head, recessed area with absence of cortical bone in the cribra femoralis region.
Vertebrae	
C1	No abnormalities observed
C2	No abnormalities observed
C3	Macroscopic: Right superior facet larger than the left, indicating asymmetry in the vertebral joints. The vertebra shows inclination and slight rotation.
C4	Macroscopic: Fragmented, with labiation on the disc that supports C5; body with slight porosity. The body tilts forward, coinciding with the inclination of C3. Sclerosis on the vertebral edge.
C5	Macroscopic: Deformation of the superior edge due to pressure from C4, narrower lower area to the left. Exostotic reaction and possible Schmorl's nodule. Wedge-shaped vertebra to the left, sclerosis on the load-bearing surfaces.
C6	Macroscopic: Continuation of the deformation from C5 on the superior edge, with exostosis. Porosity in the body. Wedge-shaped vertebra to the left, loss of cortical bone in some areas, with marked sclerosis.
C7	Macroscopic: Wedge-shaped body to the left, disc surface with porosity in the superior area, loss of cortical bone. Clear wedge shape to the left, with visible porosity in the superior areas of the vertebral body.
T1	Macroscopic: Normal articular facets and costal ends. Wedge-shaped body to the right, with the lower disc slightly rotated to the left. Wedge-shaped vertebra to the right, slight rotation of the vertebral body axis.
T2	Macroscopic: Wedge-shaped body to the right with rotation of the vertical axis, volumetric deformation of the right articular process. Wedge-shaped vertebra to the right, sclerosis in the load-bearing areas, rotation of the vertebral body.
T3	Macroscopic: Highly modified superior right process with exostosis, narrowed vertebral pedicle. Wedgeshaped body to the right. Wedge-shaped vertebra to the right, pedicle narrowing, porosity, and sclerosis in the vertebral body.
T4	Macroscopic: Right articular process with deformation and exostosis, narrowed pedicle. Wedge-shaped body to the right. Radiological: Right wedge-shaped vertebra, sclerosis in the affected areas, rotation of the body axis.
T5	Macroscopic: Normal left articular process, right with exostosis. Wedge-shaped vertebra to the left, with vascularization of the vertical axis. Radiological: Wedge-shaped vertebra to the left, sclerosis on the left vertebral edge.
T6	Macroscopic: Normal superior left process, right modified morphologically. Wedge-shaped body to the left, visible trabeculae. Wedge to the left, sclerosis in the load-bearing areas and vertebral rotation.
T7	Macroscopic: Wedge-shaped body to the left, visible trabeculae. Normal articular processes and pedicles. Radiological: Wedge to the left, visible sclerosis in the vertebral body and processes
T8	Macroscopic: Right articular process with labiation, wedge-shaped body to the left. Wedge to the left, sclerosis in the superior part of the vertebral body and right process.
T9	Macroscopic: Inferior left articular process with exostosis, normal pedicles. Body with cavitations. Radiological: Wedge to the left, areas with visible cavitations and sclerosis on the edges of the vertebral body.
T10	Macroscopic: Significantly reduced superior right process, left with exostosis. Wedge-shaped body to the left. Radiological: Wedge-shaped vertebra to the left, sclerosis in the vertebral body, dense trabeculae.
T11	Macroscopic: Absent superior right process, left morphologically modified with exostosis. Body flattened to the right. Body inclined to the right, with sclerosis and dense trabeculae.
T12	Macroscopic: Absent superior right process, body tilted to the right with slight porotic activity. Wedgeshaped body to the right, sclerosis on the articular surfaces.
L1	Macroscopic: Fragmented by the pedicles. Normal superior left process, body tilted to the right with slight porosity on the frontal view. Upper and lower discs worn with mild porotic activity. Wedge to the right, visible porosity. Fine trabeculae.
L2	Macroscopic: Absent superior left process, right normal but slightly modified. Enlarged inferior right process, seeking support on L3. Body tilted to the right, intense porotic activity on the right side. Worn discs. Wedge to the right, visible sclerosis on the load-bearing surfaces.
L3	Macroscopic: Partially preserved, with significant porosity on the left side, the only conserved part. Worn discs. Fragmented vertebral body, intense porosity. No significant structural changes observed.
L4	Macroscopic: Fragmented by the pedicles. The vertebral body exhibits asymmetric tilting to the right; partial loss of the anterior right anterolateral portion with absence of normal cortical outline; irregular porotic lesions with trabecular exposure; wedge-shaped deformation; upper and lower discs show significant wear. Radiological: Wedge-shaped body to the right, areas of porosity and cavitation in the anterosuperior part of the body, accompanied by marginal sclerosis.
L5	Macroscopic: Fragmented by the pedicles; anterior wedge-shaped deformation; partial loss of the anterolateral right portion with absence of normal cortical outline; irregular porosity with trabecular exposure;; grooves observed in the upper and lower vertebral rings.. Radiological: Dense sclerotic remodeling over the anterosuperior portion of the body; porotic and cavitated zones in the affected areas; marginal sclerosis.

absence of unequivocal diagnostic markers necessitates a cautious interpretation.

This multifaceted approach will also inform the evaluation of caregiving practices, which is explored in the following section through the application of the Index of Care.

Step 2: Assessment of care needs

The individual's daily life was likely affected by chronic pain, restricted mobility, and systemic stressors. Spinal degeneration and scoliosis would have led to progressive loss of function and chronic pain (Bridges, 1992; Waldron, 2009), with severe cases causing postural instability and biomechanical stress (Rogers, 2012). Brucellar spondylitis may have exacerbated these limitations, contributing to chronic inflammation, vertebral destruction, and episodic flare-ups of pain (Pappas et al., 2006; D'Anastasio et al., 2011), often leading to mechanical instability and physical debilitation (Bolaños Toro et al., 2022a, b).

Additionally, cribra femoralis suggests metabolic stress or past infections, which could have weakened resilience and increased health risks. This condition is linked to chronic anemia, nutritional deficiencies, and systemic infections (Walker et al., 2009; Oxenham and Cavill, 2010). Furthermore, systemic inflammatory conditions like tuberculosis and brucellosis may have contributed to bone remodeling alterations, compounding metabolic deficiencies (Weston, 2008).

Periodontal disease and tooth loss may have further impacted health by limiting nutritional intake, exacerbating metabolic deficiencies, and

Table 2
Pathological analysis.

Bone/ Region	Observed Alterations	Possible Pathologies,	Interpretation
Sternum	Fragmentation of the marginal osteophytes at the clavicular and first costal notches, partial resorption of internal cortical bone.	Osteoarthritis, subchondral sclerosis, chronic inflammation (e.g. brucellosis, tuberculosis, or other chronic infections)	The combination of osteophytes, porotic activity, and cortical loss suggests a chronic inflammatory or degenerative process. While brucellosis is a possible etiology, other chronic infections or mechanical stressors should also be considered.
Ribs	Fragmentation with cortical bone loss, evidence of periosteal reaction and marginal remodeling.	Costovertebral osteoarthritis, subchondral sclerosis, chronic infection (e.g., brucellosis, tuberculosis, or another chronic inflammatory condition).	The observed remodeling and sclerosis suggest a combination of mechanical stress and chronic inflammation. While chronic infection (e.g., brucellosis or tuberculosis) is possible, degenerative changes related to costovertebral osteoarthritis should also be considered.
Humerus	Exostotic formation along the bicipital groove, porosity on the humeral head, sclerosis at the anatomical neck.	Chronic enthesopathy, osteoarthritis, possible metabolic bone disease (osteopenia or early-stage osteoporosis).	The observed exostosis and porosity suggest a history of repetitive mechanical stress and chronic inflammation, potentially exacerbated by metabolic deficiencies such as osteopenia or early-stage osteoporosis.
Coxal	Porosity and marginal osteophytes in the acetabular rim, sclerosis and irregular remodeling in the sacroiliac joint.	Chronic sacroiliitis, osteoarthritis, possible brucellosis, tuberculosis, or other inflammatory conditions.	The combination of porosity, osteophytes, and sacroiliac sclerosis suggests a chronic inflammatory process, possibly related to sacroiliitis. While infectious causes such as brucellosis and tuberculosis remain possibilities, degenerative or autoimmune conditions should also be considered. The presence of scoliosis may contribute to mechanical stress on the sacroiliac joint, exacerbating inflammation.
Sacrum	Incomplete fusion of the transverse sacral crests, marginal osteophytes, sclerosis, and irregular cortical remodeling in the auricular surface	Chronic sacroiliitis, sacroiliac osteoarthritis, possible brucellosis, tuberculosis, or other inflammatory conditions.	The combination of sclerosis, osteophytes, and incomplete fusion suggests a chronic inflammatory or degenerative condition affecting the sacroiliac joint. While brucellosis is a possibility, tuberculosis or other chronic inflammatory disorders should also be considered. The presence of scoliosis may exacerbate mechanical stress, contributing to joint degeneration and inflammation.
Femur	Porotic lesions consistent with cribra femoralis on the femoral neck, exostotic formations on the femoral head, generalized surface porosity.	Nutritional deficiencies (e.g., anemia), metabolic bone disease (osteopenia, osteoporosis), chronic infection (brucellosis, tuberculosis).	The porotic lesions on the femoral neck suggest metabolic stress, potentially due to anemia or a chronic inflammatory condition. While chronic infection (e.g., brucellosis, tuberculosis) remains a possibility, metabolic bone disease should also be considered. Scoliosis-related mechanical stress may further contribute to cortical changes.
Cervical Vertebrae (C3-C7)	Asymmetry in vertebral facets, wedge-shaped deformation, marginal osteophytes, cortical porosity.	Scoliosis (congenital or degenerative), vertebral osteoarthritis, chronic infection (e.g., brucellosis, tuberculosis).	The observed vertebral asymmetry and degenerative changes suggest a chronic mechanical process, likely related to scoliosis and osteoarthritis. While infection (e.g., brucellosis or tuberculosis) could contribute to vertebral remodeling, the absence of severe lytic destruction makes an infectious origin less definitive.
Thoracic Vertebrae (T1-T12)	Wedge-shaped deformities, cortical porosity, marginal sclerosis, osteophytic lipping, cavitations in vertebral bodies.	Scoliosis (congenital or degenerative), vertebral osteoarthritis, diffuse idiopathic skeletal hyperostosis (DISH), chronic infection (e.g., brucellosis, tuberculosis).	The combination of vertebral wedging, sclerosis, and cavitations suggests a chronic mechanical and inflammatory process. While scoliosis and degenerative changes are the most likely contributors, chronic infection (e.

(continued on next page)

Table 2 (*continued*)

Bone/ Region	Observed Alterations	Possible Pathologies,	Interpretation
			g., brucellosis, tuberculosis) remains a possibility, particularly given the presence of cavitations. However, the absence of extensive vertebral collapse or large abscesses reduces the likelihood of tuberculosis.
Lumbar Vertebrae (L1-L5)	Asymmetric tilting; L4-L5 cortical loss in the anterolateral portion, irregular porotic lesions with trabecular exposure, wedge-shaped deformation, cavitations in the anterosuperior region, marginal sclerosis.	Chronic infectious spondylitis (e.g., brucellosis, tuberculosis), vertebral osteoarthritis, metabolic bone disease (osteopenia, osteoporosis).	The observed vertebral alterations, including cavitation, sclerosis, and cortical loss, suggest a chronic pathological process affecting the lumbar spine. These changes could be consistent with a possible Pedro Pons sign, which is often associated with brucellar spondylitis. However, vertebral tuberculosis and degenerative processes should also be considered, as they can present overlapping features. The absence of vertebral collapse or large abscesses weighs against classical tuberculosis, though an atypical presentation remains possible. Structural instability from scoliosis and potential metabolic factors may also contribute to the observed changes.
Teeth	Tooth loss with alveolar resorption (FDI 17, 18, 37), carious lesion (FDI 45), malocclusion (FDI 42, 41, 31, 32), periodontal disease with up to 4 mm of root exposure, enamel hypoplasia with accentuated growth lines.	Periodontal disease, caries, malocclusion, enamel hypoplasia; possible indicators of chronic nutritional stress, systemic inflammation, and metabolic disturbances.	The combination of periodontal disease, enamel hypoplasia, and dental wear suggests prolonged episodes of inflammatory stress and possible nutritional deficiencies. These alterations may reflect a history of metabolic or infectious conditions impacting systemic health.

increasing the risk of systemic infections (Humphrey et al., 2014; Lukacs, 2012). The combined burden of these conditions suggests that long-term care would have been essential, particularly in pain management, mobility support, and hygiene maintenance, crucial to preventing further complications and maintaining basic well-being (Jackson, 2004).

Pain management may have included the application of medicinal herbs, as documented in Roman medical treatises, or thermal therapies commonly used for musculoskeletal pain (Totelin, 2017, p. 155). Mobility support could have involved family assistance or the use of improvised walking aids, while hygiene maintenance was crucial for infection prevention, aligning with Roman concerns for bodily cleanliness and health (Jackson, 2004). The progressive nature of these conditions suggests that caregiving efforts evolved over time, adapting to increasing dependency.

Step 3: Reconstruction of caregiving practices

Given the individual's chronic conditions and increasing physical limitations, sustained caregiving would have been necessary. In Roman Malaca, care was likely provided within domestic or communal networks, where family members, enslaved individuals, or hired caregivers assisted with mobility, symptom relief, and daily tasks, as suggested by literary sources on household structures and responsibilities in the Roman world (Rawson, 2003, p. 218).

Pain management may have included herbal treatments, massages, or thermal therapies, aligning with known Roman medical practices (Totelin, 2017; Jackson, 2004, p. 50). Dietary adjustments would have been essential to compensate for dental deterioration, while maintaining hygiene was crucial in preventing infections (Lukacs, 2012p. 60; Humphrey et al., 2014, p. 954). Additionally, ritual and prophylactic practices—such as amulets or symbolic objects—may have played a role in ensuring well-being, reflecting both medical and spiritual approaches to care.

The long-term nature of these conditions suggests a gradual adaptation of caregiving efforts, evolving as mobility declined and dependency increased. This reinforces the idea that the individual was not isolated but integrated within a support system that sought to preserve comfort and dignity despite chronic illness (Rawson, 2003; Waldron, 2009).

Step 4: Sociocultural interpretation of care

The presence of sustained care in this case reflects broader Roman attitudes toward aging, illness, and communal responsibility. In a society where familial and social networks played a key role in caregiving, the long-term support provided to this individual suggests a recognition of their value and place within the community, despite their chronic health conditions (Parkin, 2004, p. 246).

This caregiving effort also highlights resilience—not only of the individual but of the social structures that enabled their care. The ability to adapt to physical decline and maintain an active role within the household or community suggests that illness did not necessarily lead to exclusion but could be accommodated within existing support systems (Parkin, 2004, p. 217).

The funerary treatment further reinforces this perspective. The careful placement of grave goods—particularly items related to personal care and protection—suggests not only an effort to maintain dignity and identity but also an act of communal remembrance, ensuring the individual's continued presence within the collective memory (Hope, 2009, 34). These elements align with Roman ideals of honoring the elderly and integrating vulnerable individuals within social and ritual frameworks (Cooper, 2012, p. 196).

Ultimately, this case underscores how care in antiquity extended beyond immediate survival, reflecting a broader concern for quality of life, resilience in the face of illness, and the enduring role of social networks in both life and death.

Table 3
Differential Diagnosis.

Pathology	Key Findings	Supporting Evidence	Evidence Against	Conclusion
Brucellosis	Vertebral osteitis with sclerosis, possible Pedro Pons sign, asymmetric sacroiliitis, focal cortical irregularities, cribra femoralis.	The observed combination of sclerosis, sacroiliitis, and cortical remodeling suggests a chronic inflammatory or infectious process affecting the vertebral column. Brucellar spondylitis has been associated with these features, but they are not exclusive to this condition. The asymmetric sacroiliitis and marginal sclerosis are often linked to chronic bacterial infections, though mechanical and degenerative factors could also contribute to these changes.	Some of the skeletal manifestations, particularly sclerosis and sacroiliitis, are also observed in other conditions, including vertebral tuberculosis, osteoarthritis, and metabolic bone diseases. The absence of vertebral collapse and large paraspinal abscesses reduces the likelihood of classical tuberculous spondylitis, but does not exclude atypical forms. The presence of degenerative changes and mechanical stress from scoliosis suggests a multifactorial etiology.	While brucellosis remains a differential possibility, the observed lesions do not provide definitive evidence to favor this over other potential causes. A combination of infectious, degenerative, and metabolic factors may have contributed to the skeletal alterations, and further analyses are necessary to refine the diagnosis.
Vertebral Tuberculosis	Vertebral osteitis with sclerosis, cavitations, absence of vertebral collapse, no evidence of paraspinal abscesses.	Tuberculosis can present with lytic lesions, sclerosis, and cavitations, similar to the observed vertebral changes. However, the absence of significant vertebral collapse and large abscess formation is atypical of classical tuberculous spondylitis. Some features, such as sclerosis and remodeling, overlap with brucellar spondylitis and degenerative changes, making differentiation complex.	The lack of extensive vertebral destruction, vertebral bridging, and large abscesses reduces the likelihood of tuberculosis. However, atypical presentations exist, and a chronic low-grade tuberculous infection cannot be entirely excluded.	Tuberculosis remains a possible differential diagnosis, though the absence of classical radiological markers makes it less likely as the primary etiology. A combination of infectious, degenerative, and mechanical factors should be considered in the overall assessment.
Osteoarthritis	Marginal osteophytes, subchondral sclerosis, irregular joint surfaces, vertebral and rib degeneration, sacroiliac joint alterations.	The widespread presence of osteophytes, sclerosis, and degenerative changes in weight-bearing areas suggests a chronic degenerative process. The impact of mechanical stress from scoliosis likely contributed to the progression of osteoarthritic changes.	Osteoarthritis does not typically cause the degree of cortical irregularity and vertebral osteitis observed in this case. It may coexist with, but does not fully explain, the infectious or inflammatory alterations present.	Osteoarthritis is a significant contributing factor to bone remodeling and degeneration, likely exacerbated by scoliosis. However, it does not account for all pathological features observed, particularly those suggestive of an infectious component.
Ankylosing Spondylitis (AS)	No evidence of syndesmophytes, absence of vertebral fusion, asymmetric sacroiliitis rather than bilateral involvement.	AS typically presents with bilateral sacroiliitis, syndesmophytes, and progressive vertebral fusion, none of which are observed in this case. The sacroiliitis is asymmetric, which is more characteristic of mechanical stress or infection rather than AS.	The absence of key radiological markers, such as syndesmophytes and vertebral fusion, significantly reduces the likelihood of AS. Additionally, the presence of focal sclerosis and vertebral cavitations is not characteristic of AS but aligns more with an infectious or degenerative process.	AS is unlikely given the absence of hallmark features and the presence of findings more suggestive of an infectious or mechanical etiology. However, other inflammatory conditions should still be considered.
Congenital or Degenerative Scoliosis	Asymmetric vertebral wedging, abnormal load distribution, progression with age, association with degenerative and inflammatory changes.	Scoliosis can lead to chronic mechanical stress, promoting asymmetric degeneration and increasing susceptibility to structural instability. The presence of scoliosis may have amplified the effects of concurrent degenerative and infectious processes.	Scoliosis itself does not directly cause infectious or metabolic bone disease but may act as a compounding factor in their progression. The distribution of sclerosis and cavitations suggests additional pathological influences beyond mechanical stress alone.	Scoliosis appears to be a significant contributing factor to vertebral remodeling and degeneration. However, the presence of inflammatory and infectious features indicates a multifactorial etiology rather than a purely mechanical origin.
Mechanical Instability (Spondylolisthesis)	Irregular vertebral wear, osteophytes, sclerosis in load-bearing areas, possible stress-related remodeling.	Chronic mechanical instability can lead to progressive degenerative changes, particularly in the presence of scoliosis. The observed osteophytes and sclerosis in key load-bearing regions suggest long-term biomechanical stress, which may have exacerbated structural weakening.	No clear radiographic evidence of vertebral slippage or severe displacement, which are hallmarks of clinically significant spondylolisthesis. Some observed alterations, such as cavitations and cortical porosity, suggest additional pathological influences beyond mechanical stress alone.	Mechanical instability likely played a role in vertebral remodeling and degeneration. However, the presence of inflammatory and infectious features indicates a multifactorial process rather than a purely mechanical etiology.
Nutritional Deficiencies	Cribra femoralis, cortical porosity, stress lines in long bones, possible metabolic imbalances (iron, vitamin C, vitamin D deficiencies).	Bone porosity and cribra femoralis are often linked to nutritional stress, anemia, or metabolic disorders. These conditions can weaken bone structure and contribute to overall skeletal fragility.	The presence of sacroiliitis, sclerosis, and vertebral cavitations suggests additional pathological processes beyond nutritional deficiencies. While malnutrition may have played a role, it does not fully explain the observed inflammatory and infectious features.	Nutritional deficiencies may have contributed to bone porosity and metabolic stress but do not account for all skeletal alterations. Their role should be considered within a broader framework of infectious, mechanical, and degenerative factors.
Dental Pathologies (Periodontitis, Caries, Enamel Hypoplasia)	Tooth loss with alveolar resorption (FDI 17, 18, 37), carious lesion (FDI 45), periodontal disease with up to 4 mm of root exposure, enamel	Enamel hypoplasia has been associated with early-life metabolic stress, malnutrition, or disease episodes, potentially indicating	While dental pathologies can reflect systemic health status, they do not directly explain vertebral sclerosis, sacroiliitis, or cortical irregularities.	Dental pathologies offer insights into general health, dietary habits, and potential metabolic stress. However, their role in the

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Table 3 (*continued*)

Pathology	Key Findings	Supporting Evidence	Evidence Against	Conclusion
	hypoplasia with accentuated growth lines.	systemic physiological stress. Periodontal disease and caries suggest chronic oral inflammation, which may be influenced by diet and overall health status. These conditions may contribute to broader skeletal stress indicators, such as cribra femoralis.	Periodontitis is primarily linked to poor oral hygiene rather than systemic disease. Caries is more closely associated with dietary habits, particularly carbohydrate consumption.	overall skeletal pathology remains secondary and should be analyzed alongside infectious, mechanical, and degenerative factors.

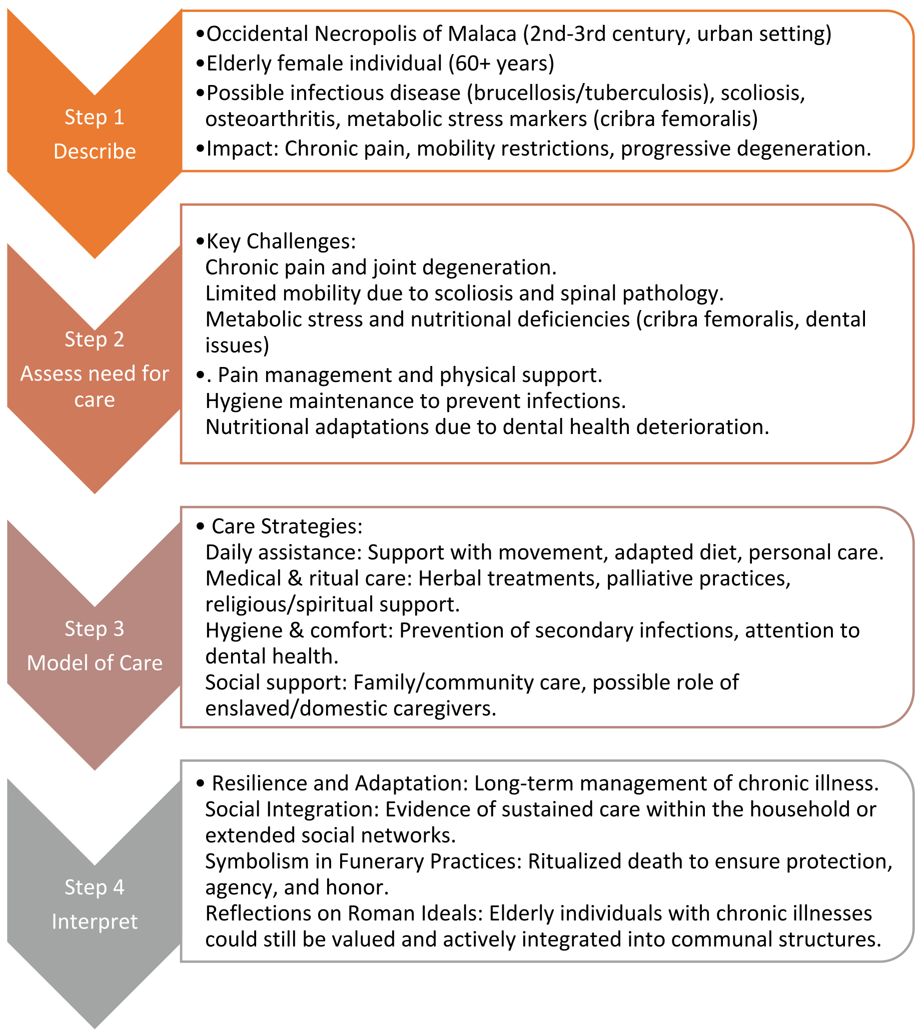

Fig. 11. Index of Care. Graphical representation of the Index of Care applied to the individual from Tomb 6. The model outlines the assessment process, from identifying pathological conditions and evaluating their functional impact to reconstructing caregiving strategies and interpreting their broader social implications within the Roman community of Malaca.

7. Conclusions

In Roman Malaca, old age and illness did not necessarily equate to social exclusion. The case of the individual from Tomb 6 illustrates how care and identity persisted beyond life, supported by both the bioarchaeology of care framework (Tilley, 2022) and the funerary practices that shaped their post-mortem presence.

The skeletal evidence reveals that this elderly individual, over 60 years old, endured chronic illness—including possible infectious disease, degenerative changes, and nutritional stress in childhood—which would have significantly impacted their daily life. However, rather than being marginalized, they likely received sustained care and support, emphasizing their value within the social structure. This long-term assistance suggests a strong network of caregivers, whether family, household members, or community figures, who ensured their well-being despite chronic health challenges.

The funerary treatment further reinforces this continued recognition of identity. The arrangement of grave goods, including personal objects linked to bodily care and protection, highlights the persistence of social and individual identity beyond death. Items from the *mundus muliebris* were deliberately included, suggesting an effort to preserve aspects of the individual's status, role, and memory. This aligns with broader Roman funerary customs, where objects were not merely offerings but active components of identity construction and remembrance.

From a broader interpretative lens, the intersection of ethnic, social, and individual identity played a fundamental role in shaping this

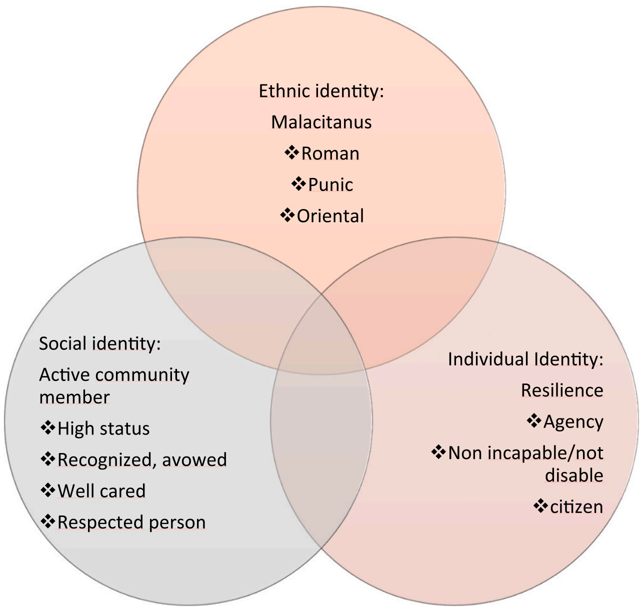

Fig. 12. Identity spheres. Venn diagram illustrating the intersection of ethnic, social, and individual identity in the case of the individual from Tomb 6. Ethnic identity reflects cultural and ancestral affiliations; social identity denotes status, community role, and recognition; and individual identity highlights personal resilience, agency, and civic status within Roman Malaca.

funerary expression. The individual was not defined solely by illness or old age but remained integrated within a complex web of community values, personal resilience, and cultural belonging. Their ethnic background, whether *malacitanus*, roman, punic, or oriental, coexisted with their social standing, marked by recognition, care, and respect, and their personal agency, reflected in the way their memory was curated in death.

Ritual elements within the burial, such as lamps, shells, and nails, further emphasize the performative aspect of funerary commemoration. In line with Bell's theory of ritualization (2009), these objects not only transformed the grave into a sacred resting space but also actively structured the individual's transition into the afterlife. Their deliberate placement within and around the coffin suggests that the community played a key role in shaping the post-mortem narrative, reinforcing both social cohesion and the deceased's continued agency in the collective memory.

Ultimately, the case of Tomb 6 demonstrates that illness did not erase identity. Instead, through care in life and commemoration in death, the individual remained a recognized and valued member of their society, embodying resilience, agency, and enduring social significance.

CRediT authorship contribution statement

Sonia López-Chamizo: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Methodology, Investigation, Formal analysis, Conceptualization.

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

No data was used for the research described in the article.

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