MATERNAL DEATH AS A REPRESENTATION OF THE WAR WITH LIFE IN WESTERN MEXICO: ANALYSIS OF TOMB II AT TINGAMBATO, MEXICO, FROM THE PERSPECTIVE OF THE BIOARCHAEOLOGY OF CARE AND THE MODEL OF THE PALIMPSEST IN HEALTH

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ABSTRACT. *This paper presents, from an approach of archaeothanatology, osteobiography, bioarchaeology of care and palimpsest, the analysis of one of the most important archaeological findings recently made in western Mexico. It is about a female person buried in a lavish tomb in the Tingambato archaeological site, Michoacán, Mexico, dated 1400 years ago, with more than 19,000 objects covering her body. This research presents the results of the work of almost a decade of studies carried out by different methods on this individual: morphophysical studies, taphonomy, dating, genetics, as well as various techniques of virtual archaeology among others. Through the Index of Care it was possible to systematize all the information obtained by different study methods and integrate it for analysis. The use of archaeothanatology and the Index of Care makes it possible to perform analyses on specific individuals from the past to establish their health conditions and the probable causes of death. The main limitation that arose was the poor state of preservation in which we received the bones, which unfortunately did not allow us to carry out some morphoscopic and taphonomic studies that would have been relevant.*

KEYWORDS. *Index of Care, Tingambato, palimpsest, maternal death, western Mexico, aDNA, paleoimagenology.*

RESUMEN. *Este artículo presenta, desde un enfoque de la arqueotanatología, la osteobiografía, la bioarqueología del cuidado y el palimpsesto, el análisis de uno de los hallazgos arqueológicos más importantes realizados recientemente en el Occidente de México. Se trata de una persona del sexo femenino enterrada en una fastuosa tumba del sitio arqueológico de Tingambato, Michoacán, México, fechado hace 1400 años, con más de 19000 objetos que cubrían su cuerpo. Esta investigación presenta los resultados del trabajo de casi una década de estudios realizados mediante diferentes métodos*

sobre este individuo: morfofísicos, tafonomía, datación, genética, así como diversas técnicas de arqueología virtual entre otras. Mediante el índice de cuidado fue posible sistematizar toda la información obtenida por los diferentes métodos de estudio e integrarla para su análisis. El uso de la arqueotanatología y el índice de cuidado permite realizar análisis sobre individuos específicos del pasado para establecer sus condiciones de salud y las probables causas de su muerte. La principal limitación que se planteó fue el mal estado de conservación en que recibimos los huesos, lo cual, lamentablemente, no nos permitió realizar algunos estudios morfoscópicos y tafonómicos que hubieran sido relevantes.

PALABRAS CLAVE. Índice de cuidado, Tingambato, palimpsesto, muerte materna, Occidente de México, ADNa, paleoimagenología.

INTRODUCTION

The archaeology of western Mexico has assumed increasing importance in recent years in our understanding of the dynamics of the relations between different cultures and eras and their connection to the landscape. The archaeological site known as Tinganio or Tingambato in western Mexico includes two tombs within a complex funerary pattern in the Mesoamerican Epiclassic (Piña & Ohi 1982; Punzo 2022).

Tomb 2 is a chamber-type tomb, consisting of a structure with a vaulted ceiling of slabs, and containing a young female individual. The burial is a paradigmatic case due to its opulent treatment and, particularly, given its association with the accoutrements of warriors within the regional funerary tradition of western Mexico and the Epiclassic.

It is therefore important to analyze the female individual in Tomb 2 within her local and regional context, combining architectural findings with a detailed description of the osseous remains with an emphasis on the conditions of her life. To do so, we used analytical tools such as health-disease care, a reconstruction of the exterior and interior of the tombs, imaging studies and the analysis of genetic material from the osseous remains as well as comparing it to other tombs from the same region and time.

With the above as a starting point, this study has been developed using the theoretical and methodological approach of the bioarchaeology of care (Tilley 2017)

Component I. Reconstruction of the Funerary Context

Component II. Morpho-physical Description and Taphonomy
- Osteobiography
- Paleopathology

Component III. Microanalysis:
- Collagen dating
- Studies of ancient genetics

Component IV. Paleoimaging.
- Virtual and digital archeology

Component V. Interpretation
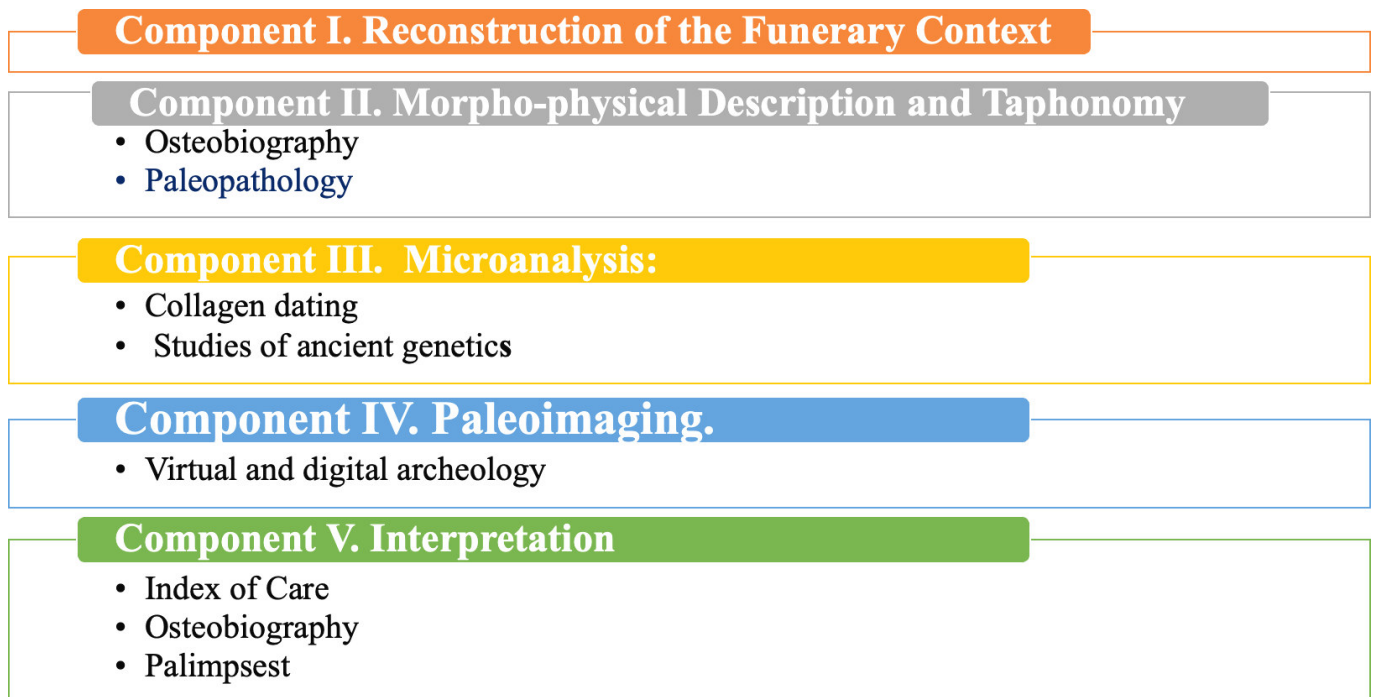- Index of Care
- Osteobiography
- Palimpsest

Figure 1. Multimethod methodology for integration into the Index of Care. The methodology used in this study was organized into components, where each component corresponds to each of the steps, methods from different scientific disciplines (components I-IV), and a last component integrates the theoretical approaches used to give an interpretation and a model proposal, such as the palimpsest.

and the palimpsest in health (Vergara 2018; Colmenares-Roa *et al.* 2022). This type of approach has become increasingly important in the study of the cultures of western Mexico, where the site of Tingambato is located, given the special attention to the cult of the dead in the funerary traditions that characterize this cultural region. The aim of this study was to describe, analyze and understand the processes of health, disease, care, and death through an analysis of the funerary context from Tomb 2 at the Tingambato site, Michoacán, and a regional comparison with other funerary sites of the cultures of western Mexico.

MATERIALS AND METHODS

A multimethod study divided into five components was conducted to integrate all the information related to the individual who laid in Tomb 2 and her context (Figure 1).

Component I. Reconstruction of the Funerary Context

Information from published archaeological studies on the Tingambato site was incorporated, as well as the reconstruction of Tomb 2 using virtual archaeology techniques to interpret symbolic structures.

Component II. Morphophysical Description and Taphonomy

The description of the osseous remains of each tomb began with a morphophysical description, taphonomy and identification of pathological lesions and traces of violence to reconstruct the osteobiography (Ortner 2003).

Component III. Microanalysis

Collagen dating and studies of ancient genetics. In this component, analyses were conducted for dating and ancient genetics. For dating, ultrafiltered collagen was extracted from a humerus bone sample. After cleaning and grinding the samples, they were submitted to a chemical procedure with low temperature and 0.5 M HCl to dissolve the mineral phase; continuing with the gelatinization process by means of an acid treatment with 0.2 M HCl at high temperature. The dissolved collagen was filtered to preserve fibers larger than 30-kD. For the study of ancient genetics, the second upper right molar of the individual found in Tomb 2 was used, and two teeth from the tooth offering were analyzed.

Sequencing was performed to determine the amount of genuine aDNA and that of exogenous DNA. The analysis included the complete genome, number of single-nucleotide polymorphisms (SNP), haplogroups, mitochondrial DNA (mtDNA), and the determination of sex and mtDNA haplogroups (Punzo *et al.* 2019).

Component IV. Paleoimaging

In this study, different methods of visual and digital archaeology were used, including photogrammetric 3D reconstruction techniques and image exploration with *multi-slice computed tomography* (MSCT, *NeuViz 12 Essence*).

The 2D tomographic reconstructions were complemented with reconstructions with a specific algorithm to obtain complementary 3D images for a morphometric analysis (Bowmaker *et al.* 2011; Conlogue *et al.* 2021).

Component V. Interpretation (Index of Care)

The Index of Care was reconstructed by submitting the information of the disaggregated analysis to the open access platform (http://indexofcare.org) (Tilley 2017, 2024).

Ethical aspects

This study was approved by the Archaeology Advisory Board (*Consejo de Arqueología-INAH*) with official document number 401.1S.3-2018/1732.
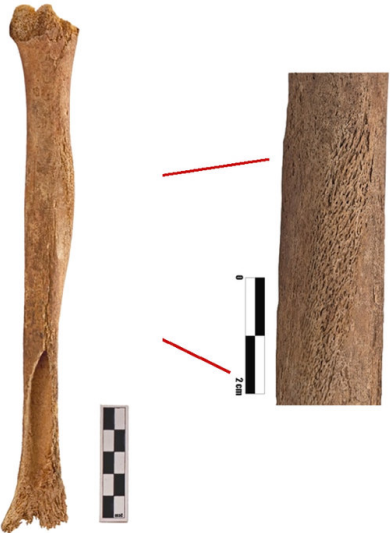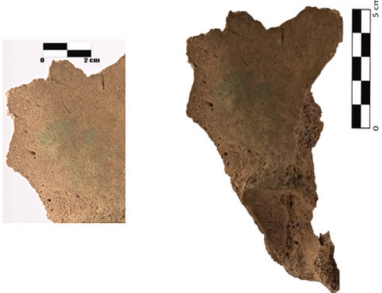
RESULTS

Index of Care. Stage 1. The Individual

Individual primary burial, located in Tomb 2 at the Tingambato archaeological site, western Mexico; Tingambato Phase 3, Epiclassic (AD 550–700)

A young woman is identified lying in Tomb 2 at Tingambato, Michoacán. Her approximate age was be-

Table 1. Description of the human bone remains. The skull was reconstructed
using photogrammetric, morphoscopic, and imaging analysis.

| Elements	Descriptions	
Bone remains	The condition of bone remains were good quality; 80% of those bones were preserved. The bones of the hands, a large part of both coxal and sacrum, the metatarsals and phalanges of the right foot, manubrium, ribs, vertebrae, occipital, scapulae, and ends of long bones were not found.	
Elements	**Descriptions**	**Example**
The upper half of the body, i.e., axial skeleton, shoulder girdle, and skull	Whitish colorations. The Periosteum (outer layer of compact bone) is formed into flakes. It is better observed in the detailed image of the frontal squama (lower right)	
Proximal third of the left humerus (posterior view).	Periostitis present in the proximal end (upper image) and a detail of the area (lower image) where the abnormal bone growth can be better observed.	
Right tibia diaphysis	Horizontal cuts, wide and short length. Compatible with rodent traces.	
Left iliac bone.	Green coloration is observed in the central part of the iliac fossa.	
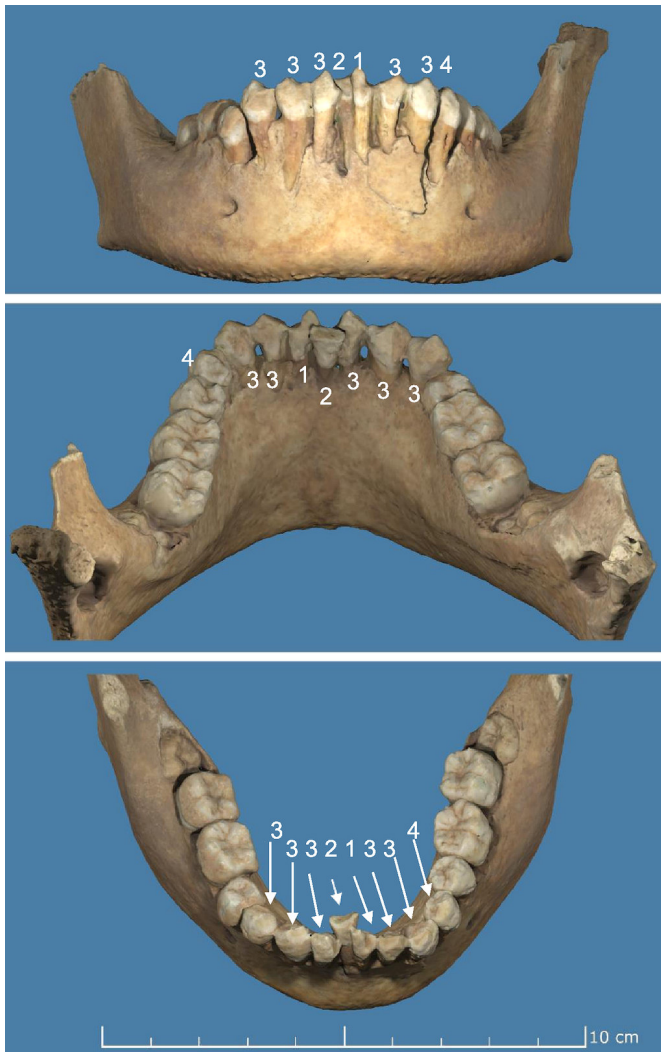
Figure 2. Intentional cultural dental modifications. The models indicate the different intentional cultural modifications observed in mandibular teeth, estimated as: 1) Type B4 in the left central incisor; 2) Type B7 in the right central incisor; 3) Type F4 in both lateral incisors, in both canines and in the right first premolar; and 4) Type B1 in the left first premolar.

Figure 3. Indicators of stress: Porotic Hyperostosis (a, b).

tween 16 and 19 years (morphophysical description and MSCT reconstruction). The estimation of age at death and the degree of ossification was assessed using the data proposed by Schaefer *et al.* (2009) and by the degree of dental development proposed by Ubelaker (2007), which shows the age at which each tooth erupts. The mtDNA indicates that she is female, with 9,888 nuclear hits of chromosome X and 100 of chromosome Y, with an XY ratio of 0.0011–0.0012 (1 standard deviation). The haplotype (mtDNA) was type A2q1, with a height between 1.45 and 1.47 meters. The description of the human bone remains elements may be observed in Table 1.

Cultural modifications were observed in some maxillary and mandibular teeth (Romero 1986) (Figure 2).

Integrating the analysis of Components II and IV, the following indicators of stress and pathologies were identified: Porotic hyperostosis was observed in both parietal bones, near and parallel to the sagittal suture and along the parietal tuberosity, corresponding to a stippled pitting pattern running from anterior to posterior parallel to the sagittal suture (Figure 3a and 3b) as well as incipient *cribra orbitalia* and dental enamel hypoplasia. Data compatible with periostitis (immature bone formation with a porous presence and irregular orientation, in both humeri, it is located on the deltoid tu-

Figure 4. 2-D and 3-D volume-rendered CT. Bone remains of a young individual, with incomplete skull due to the absence of bones of the cranial base and multiple fractures in the calotte bilaterally. Brachycephalic deformation (tabular erect) of the skull. Bones of the face with partial loss of the left upper jaw and partial edentulous with dental decoration.

berosity and in the left humerus and the crest of the greater tubercle) were observed in the long bones (Figure 4 and Table 1).

Mortuary Context

The archaeological zone of Tingambato is in the State of Michoacán, Mexico, near the town of the same name. Situated at an altitude of 1,928 meters above sea level, it is bordered to the north by the municipalities of Nahuatzen and Erongaricuaro, to the east by the municipalities of Salvador Escalante and Ziracuaretiro, and to the west by the municipalities of Uruapan and Nahuatzen (INEGI 2009). Tomb 2 is located under a small mound at the Patio Hundido 2 of the Tingambato archaeological site, to the north and equidistant

to Tomb 1, which is located below a room complex in front of Plaza 1. Tomb 1 is a multiple and mixed burial (Figure 5).

Tomb 2, dated AD 597–670, is comprised of a quadrangular base measuring 3.40 meters on its north-south axis and 3.50 meters on the east-west. It is excavated in the filling from the leveling of Tingambato Phase 3. The walls have an average height of 1.30 meters topped by the vault, consisting of large slabs that are concentrically oriented in a right-left direction until they join in the center. These slabs are joined by earthen mortar and close at a height of 2.05 meters. The entrance is approximately 80 centimeters by one meter wide with a slab that supported substantial weight.

Some structural aspects of Tomb 2 could not be described due to the collapse sustained during the excavation process in 2011, but the structural system of Tomb 2 is like that of Tomb 1, which is fully preserved. The mortuary chamber is aligned with the adjoining courtyards to the east, indicating that they were built in the last stage during the construction of the great platform, corroborated by carbon-14 dating. This tomb is located under a mound built after the tomb with a *talud-tablero* decoration; this wall limits accessibility to the tomb.

A female individual, placed on a bed of stone slabs, was found in the northern half of the chamber in an extended dorsal decubitus position with the head pointing westward and the feet to the east (Punzo 2022). She was accompanied by a large offering consisting of grave goods of 18,601 pieces made of shell and sea snails weighing 2,132.5 grams from various species, including *Spondylus princeps*, in addition to earrings, rings, inlays, adornments, bells, and a composite ear flare. She was also found with five pairs of atlatl handles and 827 lapidary elements, primarily of amazonite, and some turquoise tesserae (Valdés 2018; Punzo 2022). In addition, 39 dental crowns were found corresponding to 38 permanent teeth and one deciduous or temporary tooth. The teeth associated with the woman of Tomb 2 belong to different individuals, all except for one individual less than 10 years of age at the time of the funerary deposit (Figure 5).

The funerary customs of the Tingambato site and especially of Tomb 2 are elaborate, which is reflected in the grave goods of green stone, shells, and the teeth of subadult individuals as well as an element associated with war such as the atlatl. These support the hypothesis of a young woman to whom a tribute is being paid.

Index of Care. Stage 2. Disability and Need for Care

A differential diagnosis would be necessary to determine the origin of periostitis, since this can be due to chronic inflammation secondary to a metabolic disease, a generalized or localized infectious disease, non-specific alteration of the immune system or musculoskeletal overload. Based on current medical evidence, it can be inferred that this can limit activities of daily living. In general, periostitis is acquired and does not compromise the life of the individual.

It is controversial to consider stress indicators as pathologies in and of themselves; rather, they indicate poor health conditions, such as chronic anemia, as is the case of porotic hyperostosis (PH) and *cribra orbitalia* (CO) (Brickley 2018; O'Donnell 2019; O'Donnell *et al.* 2023; Rothschild *et al.* 2021; McCool *et al.* 2021; Anderson 2021; Biehler-Gomez *et al.* 2023).

In recent years, the presence of CO has been questioned as an indicator of anemia or other specific condition, for Rothschild *et al.* the presence of lesions compatible with CO are due to vascular changes rather than pathology (Rothschild *et al.* 2021), however several articles in 2023 contradict this position (O'Donnell *et al.* 2023; Biehler-Gomez *et al.* 2023) and maintain that both CO and PH are indicators of pathological processes such as anemia; in this sense there is evidence from ancient DNA to support this association (Ferrando-Bernal 2023).

Chronic anemia is a hematological disorder secondary to nutritional deficiency or conditions produced by a chronic or acute bleeding, including those related to abnormal menstrual bleeding or hemorrhages during childbirth; the latter can lead to death (Figures 3a, 3b and 4) (WHO 2024a, 2024b; The WOMAN-2 trial collaborators 2023).

Considering the impact that anemia has on the performance of the individual, it may be inferred that the women may have experienced some of these symptoms, with an impact on her daily life. If we consider the hypothesis of a probable death during childbirth, we could relate it to the indicators of chronic anemia and its risk of increased maternal mortality.

The woman was an important person in her community, considering the complex mortuary ritual; without a doubt she received some care that allowed her to reach a certain age, that is, to survive several infections but not the risk of maternal death, hence her mortuary treatment as a warrior woman.
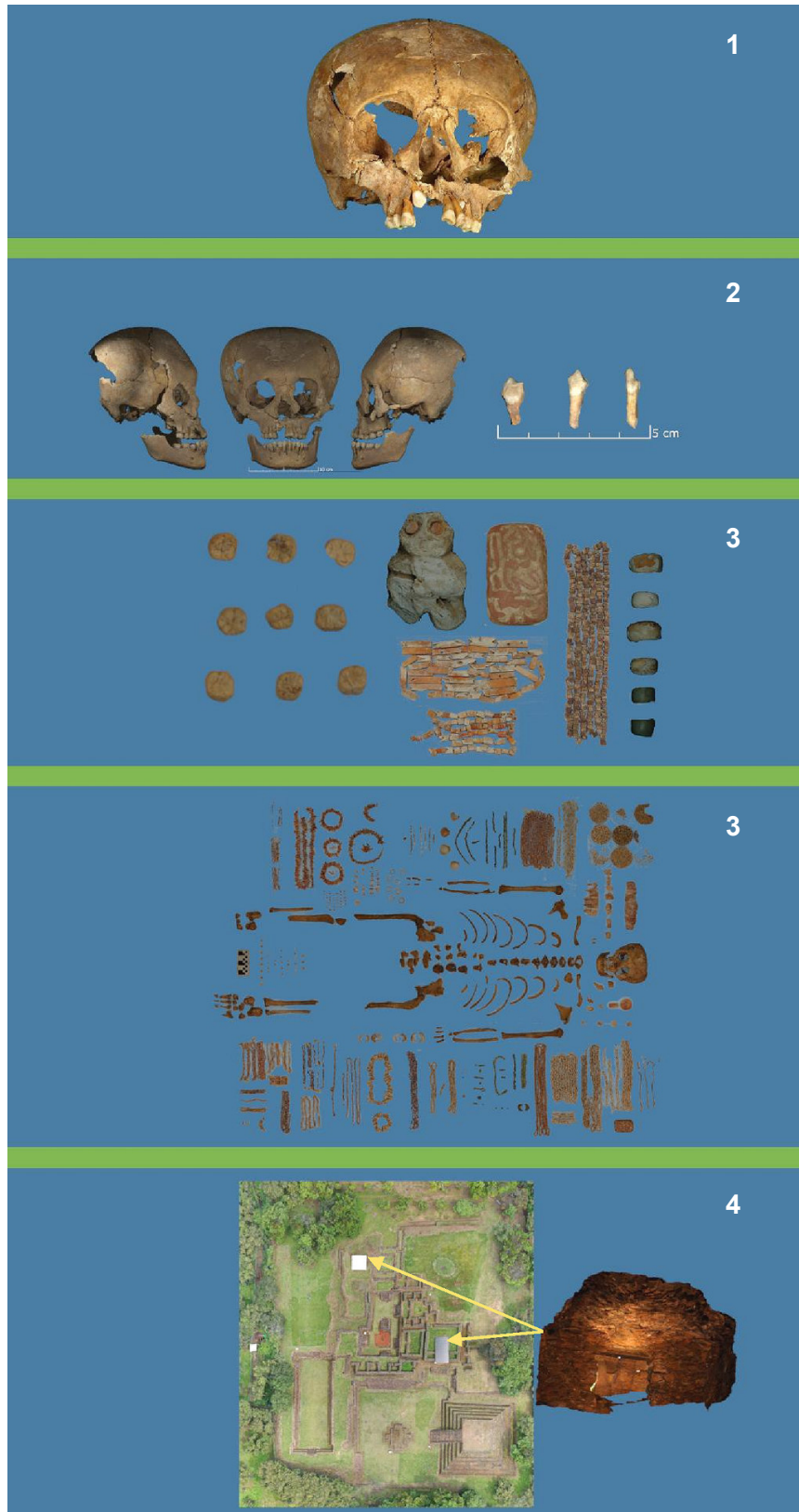
Figure 5. Model of the palimpsest: A proposal to complement the understanding of the health-care-death phenomenon in the past. Layers: 1) Health conditions; 2) cultural modifications of the body; 3) funerary offerings (grave goods); 4) funerary architecture. The palimpsest expresses the complexity and interaction of individual and social processes present in the phenomenon of health-care-death to understand part of the meaning of death in the culture of the Tingambato site. In the case of the *princess*, these human remains reflect a woman, young and of childbearing age, belonging to a social group of some privilege or who, due to her actions in life (the presence of atlatl handles being associated with warriors in other Mesoamerican cultures), merited special treatment in death, as may be documented with the accompaniment of grave goods abundant in lapidary and shell objects and even the teeth of filially unrelated children and adolescents (this can at least be argued by the morphoscopic analysis since mtDNA analysis was inconclusive).

Stage 3 and Stage 4. Definition of the Care Model

It is difficult to establish a model based on the parameters required in the index, that is, the duration of care, the efforts of the caregiver and the person receiving care.

DISCUSSION

Complementing the approach of the Index of Care, we proceeded to reconstruct the model of the palimpsest (Figure 5).

The palimpsest expresses the complexity and interaction of individual and social processes experienced by individuals and is understood as an intersectionality (Colmenares-Roa *et al.* 2022). The recognition of these interconnected layers produces an understanding of the phenomenon of health-care-death to understand part of the meaning of death in the culture of the Tingambato site.

Following the model of the palimpsest, the first interpretive layers would be in the health conditions of the woman (Figure 5).

Layer 1. Health Conditions

The aDNA analysis indicated that she was a woman due to the results provided by the ratio of hits of chromosomes X and Y. The mtDNA analysis of haplogroups or lineages reports that she belonged to haplogroup A2q1. Haplogroup A is that most frequently found in different studies conducted in Mesoamerica, both among ancient and contemporary populations (Acuña & Contreras 2022; Manzanilla-Naim 2022).

In this woman, four indicators of stress documented in different studies on Mesoamerica were identified: *cribra orbitalia*, porotic hyperostosis, enamel hypoplasia, and periostitis. *Cribra orbitalia* and porotic hyperostosis: These manifestations or indicators of stress are described as indicators strongly associated with endemic infectious diseases coupled with a hostile environment or with diseases caused by opportunistic microorganisms in conditions of chronic malnutrition (iron deficiency), inflammatory processes, anemia, and episodic hemorrhagic processes (López 2022; O'Donnell *et al.* 2023; Biehler-Gomez *et al.* 2023; Ferrando-Bernal 2023). It has been documented that there are no differences between men and women in the presentation of these stress indicators; however, it is necessary to consider some biological conditions of women that can contribute to anemia, such as abnormal bleeding during menstruation as well as acute hemorrhages during childbirth that can lead to death (The WOMAN-2 trial collaborators 2023). Pregnancy and childbirth in the pre-Hispanic Nahuatl world have been described as an intrauterine struggle against adverse forces at the birth of the child, beginning now from conception and ending with the delivery. In childbirth, whether the battle was won or lost, the woman was considered a warrior (Johansson 2018).

This is important to note because women who died in childbirth in Mesoamerica were afforded special mortuary treatment and were considered warriors. In some funeral contexts, therefore, offerings of weapons used during the war are observed (Pereira 1997). These observations related to the processes of reproductive health-disease in women, can be hypothesized as potential explanations for the stress indicators found in the woman and as a potential cause of her death, especially if we consider that part of her mortuary offering included an element of war (the six atlatl handles). This remains as a hypothesis since the reconstruction of the archaeothanatological process was limited due to the destruction during the excavation of Tomb 2, and the pelvis was destroyed in such a way that it could not be analyzed.

Layer 2. Cultural Modifications of the Body

The woman in Tomb 2 had tabular-erect cranial modification, which has been identified as early as 8500 to 7000 BC in Mesoamerica and is most frequently documented in the Prehispanic population during the Classic and Epiclassic periods (Tiesler 2022). In addition, dental modifications were identified as aesthetic elements modifying the dental physiology, producing stress, alterations in the functionality of chewing, increase in the rate of caries, and in the pulp response that leads to premature tooth loss (Tiesler 2022).

Layer 3. Funerary Offerings (Grave Goods)

The rich offerings of shell and lapidary have already been described. Another important element in this layer is the offering of human teeth of young people filially unrelated to the woman in Tomb 2, in which we find some dental pathologies (enamel hypoplasia) associated with intra-uterine stress processes since they were observed in residual teeth. One of the haplotypes of the

molars of the tooth offerings corresponds to H2a2a1 and H5a1i; unfortunately, these cannot be interpreted, as the samples were insufficient (less than 2,500 SNPs), to estimate the haplogroups.

Layer 4. Funerary Architecture

The architectural complexity of the tomb compared to those documented for the Epiclassic in western Mexico, and the not easily accessible location, also represents a special treatment at the social and perhaps political level. There are no tombs with a single individual with such an abundant funerary offering in the other sites in western Mexico, supporting the hypothesis of a special treatment for a young woman.

Several limitations were identified in this study. The first involves not having a detailed record of the context due to the conditions of discovery and excavation, when the roof of the tomb collapsed on the osseous remains. The second limitation was not having results of the isotopic analysis that would allow us to identify the origin and mobility of the *princess*, dietary patterns, and health inequities.

CONCLUSION

The Index of Care was useful to systematizing information collected from different sources, starting from a condition of food insecurity, but not social precariousness, such as anemia in the former and the social context inferred by the complex mortuary treatment, rich offerings, and especially the presence of elements associated with war (atlatl handles) in the latter, from which we were able to generate a hypothesis of a possible cause of maternal mortality.

Competing Interests

The authors declare that they have no competing interests.

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