

Headless Burials from Pachacamac, Peru: A Taphonomic Approach to Reconstructing Mortuary Ritual

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ABSTRACT

A paleoradiographic survey of funerary bundles (*fardos*) from a Late Intermediate Period (1000 A.D.–1472 A.D.) cemetery in Sector 3 of the site of Pachacamac, Peru, demonstrated that 15 out of 61 individuals had had their head removed when the body was in an advanced state of skeletonization/mummification. Detailed analysis of the field report, the *fardos* themselves, and X-rays and computed tomography scans of the *fardos* suggested that nine of these individuals were potential candidates for head removal in antiquity. Of those nine, six appeared to be clear examples of this practice. The analysis of multiple lines of evidence suggests that the use of this cemetery was complex, as part of a dynamic mortuary program that involved exposing the body for varying lengths of time and repeated excavations for new interments when earlier burials were encountered. We conclude that these heads were removed from funerary bundles when graves were being dug for subsequent burials and the specific identity of the bundled individual had been lost. When considered within the abundant archaeological record of decapitation in the Pre-Hispanic Andes, as well as ethnohistoric accounts, this pattern is consistent with reported retrieval of heads as material manifestations of ancestors. However, when placed within the broader context of contemporary sites from the Central and Southern Coast, it is clear that specific cultural motivations may have varied through space and time.

Keywords: Peru; Pachacamac; headless burial; mortuary archaeology; Pre-Hispanic

L'étude paléoradiographique de paquets funéraires (*fardos*) provenant d'un cimetière de la période intermédiaire tardive (1000 A.D.–1472 A.D.) dans le secteur 3 du site de Pachacamac, Pérou, a démontré que 15 des 61 individus avaient subi une ablation de la tête lorsque que le corps était dans un état avancé de squelettisation/momification. L'analyse détaillée du rapport de fouille, des *fardos* eux-mêmes, ainsi que les résultats des

radiographies et des tomogrammes des fardos suggèrent que neuf de ces individus figuraient comme des candidats potentiels à la décollation sur la période considérée. Sur ces neuf individus, six d'entre eux semblent être des exemples clairs de cette pratique. L'analyse de plusieurs sources de données suggère que l'utilisation de ce cimetière était complexe et s'inscrivait dans le cadre d'un système mortuaire dynamique qui impliquait l'exposition du corps pour des durées variées ainsi que l'exhumation d'anciennes tombes pour procéder à de nouveaux ensevelissements. Nous concluons que ces têtes ont été soustraites des paquets funéraires lors du creusement de nouvelles tombes lorsque l'identité spécifique de l'individu anciennement inhumé avait été perdue. Si l'on tient compte de l'abondante documentation archéologique sur la décapitation dans les Andes pré-Hispaniques, ainsi que les récits ethnohistoriques, ce schéma est cohérent avec la récupération des têtes en tant que manifestations matérielles des ancêtres. Cependant, en se plaçant dans le contexte plus large des sites contemporains de la côte centrale et méridionale, il n'est pas à écarter que les motivations culturelles spécifiques aient pu varier dans l'espace et dans le temps.

Mots clés: Pérou; sépulture sans tête; archéologie mortuaire; préhispanique

Un estudio paleoradiográfico de fardos funerarios del Período Intermedio Tardío (1000 d.C.–1472 d.C.) del cementerio en el Sector 3 del sitio de Pachacamac, Perú, demostró que 15 individuos de un total de 61 personas les habían extraído la cabeza cuando el cuerpo se encontraba en un estado avanzado de esqueletización/momificación. Análisis detallado del informe de campo, los fardos mismos, como también las radiografías y las tomografías computarizadas de los fardos sugirieron que nueve de estos individuos eran potenciales candidatos para la remoción de cabezas en la antigüedad. De esos nueve, seis parecen ser claros ejemplos de esta práctica. El análisis de múltiples líneas de evidencia sugiere que el uso de este cementerio fue complejo, como parte de un programa mortuario dinámico que implicó la exposición del cuerpo durante períodos de tiempo variables y excavaciones repetidas para nuevas inhumaciones cuando se encontraron entierros anteriores. Concluimos que estas cabezas fueron retiradas de los fardos funerarios cuando se cavaban las tumbas para entierros posteriores y se había perdido la identidad específica del individuo envuelto. Cuando se considera dentro del abundante registro arqueológico de decapitaciones en los Andes Pre-hispanos, así como los relatos etnohistóricos, este patrón es consistente con la recuperación de cabezas reportada como manifestación material de los antepasados. Sin embargo, cuando se les sitúa dentro del contexto más amplio de los sitios contemporáneos de la costa central y sur, queda claro que las motivaciones culturales específicas pueden haber variado a través del espacio y el tiempo.

Palabras claves: Perú; Pachacamac; entierro sin cabeza; arqueología mortuoria; Prehispánico

Pachacamac is a monumental administrative and pilgrimage center that was occupied from the Early Intermediate Period (0 A.D. to ca. 600 A.D.) through the Spanish Colonial Period (post 1532 A.D.) on the Central Coast of Peru. Located just south of the modern city of Lima, it served as the capital of the Ychsma Culture from ca. 1100 A.D. to ca. 1470 A.D. (Pozzi-Escott 2010 [the chronology used here follows Pozzi-Escott (2017)]; see Table 1), when it was conquered by the Inca, and the eponymous deity, Pachacamac, was incorporated into the Inca pantheon. The site's role as a pilgrimage center was probably locally focused until the Inca conquest, after which its importance as a destination for the faithful greatly increased (Owens and Eeckhout 2022).

The focus of this article is a sample of headless individuals from one of the cemeteries at Pachacamac. Decapitation, in both iconographic and physical forms, played a central role in ritual practice in the Pre-Hispanic Andes. Reviews of the practice have documented cases of decapitation in the Cupisnique and Moche societies of the North Coast (Cordy Collins 2001), Carmichael (1988, 1994, 1995) has written extensively on the practice in the Nasca society on the South Coast, Tung (2008) and Tung and Knudson (2008, 2010) have documented the practice at the Wari site of Conchopata, and Ogburn (2007) and several Spanish chroniclers (e.g., Betanzos 1996 [1576]:41) have described the display of defeated leaders' heads by Túpac Inca Yupanqui. Verano (2015) has offered a

Table 1. Chronological Sequence of Pachacamac (after Pozzi-Escott et al. 2017:Figure 6)

Chronology	Period	Culture	Constructions in the Sanctuary
1470 A.D.–1532 A.D.	Late Horizon	Inca occupation	Temple of the Sun/Acllawasi
1000 A.D.–1470 A.D.	Late Intermediate Period	Ychsma	Pyramids with ramps
600 A.D.–1000 A.D.	Middle Horizon	Pachacamac/Neveria	Painted Temple/Temple of Pachacamac
0 A.D.– 600 A.D.	Early Intermediate Period		Old Temple

comprehensive treatment of the subject, focusing on nonstandard mortuary treatments in the Andes. Many discussions of decapitation make a distinction between taking the head of an enemy and taking the head of an ancestor (cf. Arnold and Hasdorf 2008). The former was a punitive political act, while the latter was a powerful link to ancestral vitality and fertility (Arnold and Hasdorf 2008; Carmichael 1994; Toyne 2015). Thus, this article seeks to place the sample of headless burials from Pachacamac within the larger context of the decapitation tradition in the Andes to shed new light on this practice and on funerary activities at Pachacamac.

Context

The site of Pachacamac was first systematically excavated by Max Uhle (1903), who estimated that there were 80,000 individuals buried at the site. Uhle (1903) identified six cemeteries at the site, and additional burials have been found in many other contexts across the site, including areas excavated in the past 25 years by Proyecto Ychsma in 1999–2003 (Eeckhout 2004; Owens and Eeckhout 2015), the Pachacamac Archaeological Project directed by Izumi Shimada starting in 2003 (Takigami et al. 2014), the ongoing Proyecto

Arqueológico de Valle de Pachacamac (Palma and Makowski 2019), and several conservation and excavation projects of Museo Pachacamac undertaken since 2008 (e.g., Pozzi-Escot et al. 2018). This history was recently reviewed by Fuentes et al. (2022).

A Pre-Hispanic cemetery was encountered during landscaping work as part of the construction of a new national archaeology museum dubbed MUNA (Museo Nacional de Arqueología del Perú). The cemetery was located outside of the main sanctuary in an area designated as Sector 3 (see Fig. 1). It was excavated in 2015 by Jhon Baldeos (2015) and again in 2016 and 2019 by Baldeos and Sara García (García and Baldeos 2020). In 2015, 138 funerary contexts were identified (Baldeos 2015:8), including 78 more or less intact fardos (Baldeos 2015: 50) (a “fardo” is a structured bundle of textiles that contains an individual and associated grave goods), skeletonized individuals, and secondary burial deposits and other offerings (Baldeos 2015). The uppermost layer of the cemetery included many disturbed deposits of human remains. In the later campaigns, rescue excavations were undertaken in areas of a recent chicken farm, aquifer, and sand mining operations. This much-disturbed context yielded 31 “fortuitous findings,” including many deposits of disturbed human bones and other archaeological material, including 15 fardos (García and Baldeos 2020). The Sector 3



Figure 1. Map of the site of Pachacamac showing the location of Sector 3 and the MUNA cemetery in relation to the main part of the Sanctuary. Source: Museo Pachacamac.

cemetery was believed to date from the late Middle Horizon (600 A.D. to 1000 A.D.) to the early Late Horizon (1470 A.D. to 1532 A.D.) (Baldeos 2015).

The cemetery is described as being in a sandy matrix with no evidence for individual tomb cuts or tomb architecture. The uppermost layers had been disturbed by sand mining in the 1960s. The burials were encountered between a few centimeters and 140 cm below the surface. Baldeos (2015) excavated in a series of arbitrary levels (see below for a discussion of chronology).

In 2019, the Mummies as Microcosms Project (MaM) (Nelson et al. 2021) began working in collaboration with Museo Pachacamac to undertake a paleoradiographic, bioarchaeological survey of the fardos from the Sector 3 cemetery. This undertaking is part of a broader research program that seeks to shed light on the biological and cultural characteristics of the occupants of the Central Coast of Peru from the Middle Horizon through the Late Horizon. Fardos were given an initial visual inspection to assess overall preservation. Then, well-preserved fardos were imaged using plane radiography to assess internal preservation and suitability for computed tomography. Finally, a select sample was subjected to computed tomography (CT). Minimally invasive samples of textile were taken for ^{14}C analysis and, where accessible, through preexisting openings in the wrappings, and hair samples were obtained for carbon and nitrogen isotopic analysis. In 2022, the project was joined by coauthor PK, and archaeoentomological samples were taken from the fardos. At the time of writing, we have examined 70+ fardos, X-rayed 61, and collected CT scans of 48. We have additional X-rays and CT scans of fardos from other contexts at Pachacamac as well as other sites on the Central Coast for regional comparisons.

The paleoradiographic approach emphasizes the use of nondestructive imaging to visualize the contents of the fardo (Nelson et al. 2021). Fardos are traditionally studied by unwrapping them (e.g., Diaz 2015; Frame et al. 2004, 2012; Frame and Falcón 2014). This process yields important information about body modification (e.g., tattoos), textiles, and wrapping details, but it destroys the context of the fardo, and once the fardo is separated into its components (metals, textiles, bones, etc.), the components are typically curated in different parts of a museum, making it difficult to reconstruct that context (cf. Ordoñez 2019). While paleoradiography will never recover the full range of information available from an unwrapping (cf. Sutherland 2019), it does not destroy the context, and the bundle can be revisited subsequently with different analyses/techniques. The plane X-ray survey provides a low cost means of rapidly and nondestructively surveying a large number of bundles.

In the course of this survey, it became clear that several of the individuals inside the fardos did not have heads. Given the importance of decapitation in Andean ritual practice discussed above, this article focuses on these individuals to better understand this element of the mortuary ritual at Pachacamac. For the purposes of clarity, in the following descriptions, the term “head” will refer to the cranium and mandible, with variably adhering cervical vertebrae and associated desiccated soft tissues.

Methods

The MaM project takes a multimodal approach to the study of Pre-Hispanic fardos, emphasizing nondestructive/minimally invasive methods to maximize the recovery of data. We start with visual inspection of the fardos to assess their state of preservation, and then we record them using photography and drawing, and we make observations about their method of wrapping, any visible artifacts, bones, or mummified body parts. Several fardos were found to have been exposed to water and were referred for conservation (Shigwekawa 2021).

Fardos deemed to be stable were then subjected to plane radiography. We used a portable X-ray source together with a digital X-ray receptor. We used two receptors: in 2019, the size was 30×30 cm, and in 2022, we had a 14×17 in. (35.6×43.2 cm) plate. Fardos for adult individuals can be quite large, so we created a mosaic of individual images using the stitching function in Photoshop (v. 13 and 16). For details of the principle of mosaic imaging of large objects, see Conlogue (2020), and for the specific application to fardos and details of image stitching, see Motley (2022:Appendix B). Note that the size of the panel makes a critical difference when stitching the images. A large fardo would need as many as 24 individual exposures with the small panel, while it would only need six with the larger panel. The smaller number of larger images greatly reduces registration errors (see Motley 2022).

We took CT scans in July and August 2019, December 2021, and June 2022 using Siemens scanners (SOMATOM Definition AS and SOMATOM go.Up) at the Resocentro clinic in Miraflores. The scanner settings were as follows: minimum available slice thickness (0.5 mm and 0.6 mm), 110 or 120 kVp, 160 mAs, pitch factor of 1.2, and an abdomen protocol. Scans were visualized using ORS^{si} and Dragonfly v. 2022.2 (<https://www.theobjects.com/dragonfly/index.html>).

The individuals in these fardos are considered Type II mummies following the typology proposed by Vree-land (1998). That means that cultural practices, such as wrapping the bodies in absorbent textiles and burying

them in an environment conducive to desiccation, enhance the natural processes of mummification (see Motley 2022). This leads to quite variable preservation of soft tissues.

Bioarchaeological analysis includes the determination of age, sex, pathological conditions (both soft tissue and osteological), trauma, dental health, and cranial modification. Standard osteological techniques are used to determine sex (cranial and pelvic characteristics) and age (dental wear, spinal degeneration, cranial suture closure) following Buikstra and Ubelaker (1994), with methods modified for use on X-ray or CT data (e.g., using Wink [2014] to assess the pubic symphysis on CT scans). Age ranges for adults (young: 21–35; middle: 35–50; old: 51+) followed Buikstra and Ubelaker (1994).

We took ^{14}C samples opportunistically through pre-existing openings in the fardos' wrappings. The innermost accessible textile was sampled to avoid potential confusion arising from any rewrapping of the bundles that might have taken place. The Radiochronology Laboratory at Université Laval in Laval, Quebec (<https://www.cen.ulaval.ca/en/infrastructures/radio-carbon/>), prepared the samples using chemical pretreatment (HCl–NaOH–HCl), combustion, extraction, and purification of the CO_2 . The CO_2 was then graphitized and pressed into a target. The graphite targets were shipped to the Keck Carbon Cycle AMS facility at the University of California, Irvine (<https://sites.ps.uci.edu/kccams/>), for accelerator mass spectrometry counting. Calibration of the ^{14}C dates was done using the SHCal20 curve (<http://calib.org/calib/calib.html>), following the recommendations of Marsh et al. (2018: 932) and Hogg et al. (2020:774) as the Central Coast of Peru is south and west of the Intertropical Convergence Zone.

Archaeoentomological analysis follows the principles and methods of forensic entomology, adjusted for the bioarchaeological context (see Huchet 2014) in order to understand the depositional history of a burial. This analysis yields important information about the elaboration of the funerary ritual, particularly with regard to the length of time between death and burial. PK collected more than 450 insect fragments (Diptera, Coleoptera, Phthiraptera, and other Arthropoda) from the fardos featured in this article. Identifications were made under a stereo microscope at family, subfamily, genus, and, where possible, species level. This primordial sorting allowed us to familiarize ourselves with the material. Most specimens were represented by fragmentary remains. Diptera fragments were identified using dichotomous keys and reference collections (Giordani et al. 2018; Greenberg and Szyska 1984; Huchet and Greenberg 2010; Lowenberg-Neto and Carvalho 2013; inter alia). Details of the Calliphoridae

Table 2. The key stages of the life cycle of Peruvian Calliphoridae (the blow fly) and the colonization of a corpse. After Greenberg & Szyska (1984).

Event	Duration*
Colonization of the corpse—eggs laid	within minutes (pioneering flies)
Eggs hatch to become larvae (maggots)	ca. 24 hours (1 day)
Larvae pass through stages	ca. 50 hours (2 days)
Larvae develop into pupae	ca 130 hours (5.4 days)
Pupae develop and hatch to become adults	ca. 140 hours (5.8 days)
Adults leave the corpse	after 10 to 15 days of eggs being laid

The key stages of the life cycle of Peruvian Calliphoridae (blow flies) and the colonization of a corpse. After Greenberg & Szyska (1984)

* Insects, like all arthropods, are poikilothermic (coldblooded) and their timetable is primarily temperature driven and varies substantially depending on the species. Rate of development may be species specific and is influenced by biotic factors, e.g. maggot mass that can significantly accelerate rate of development; and state of the body (clothed or naked, mutilated, etc.).

(blow flies) are presented here. See Table 2 for the life cycle of the Peruvian blow fly.

The funerary taphonomic approach (cf. Knüsel and Robb 2016) is used in the analysis of these fardos. Taphonomy is the study of the processes that alter or create a particular context in the archaeological or paleontological record (cf. Efremov 1940), and funerary taphonomy uses this method to interpret data in the mortuary context (Knüsel and Robb 2016). See Motley (2022) for a detailed discussion of this approach as applied to the analysis of fardos.

Results

Fifteen fardos were identified as being of interest for this study as the X-rays clearly demonstrated that they were missing the head. Detailed examination of the X-rays, CT scans, and the wrappings themselves yielded five potential scenarios to explain the lack of the heads:

1. the fardo was a secondary burial that only included part (not including the head or skull) of the original skeleton;
2. there were inconsistencies between the field report and what we were able to observe, making it impossible to make an unambiguous interpretation;
3. heads that had become separated from the fardo since excavation;
4. heads that were removed, but no attempt had been made to restore the resulting hole in the wrappings; and
5. heads that were removed with some attempt to replace/restore the wrappings.

Fardos assigned to Categories 1 to 3 ($N = 6$) were removed from subsequent analysis.

The distinction between Categories 4 and 5 was maintained because it was impossible to know if a head that had been extracted with no attempt to restore the wrappings (Category 4) was removed in antiquity or by looters in more recent times. It was deemed unlikely that a modern looter would attempt to restore or rewrap a bundle after they had removed the head (Category 5), so these heads were deemed to have been removed in antiquity. Category 4 included three fardos and Category 5 included six.

Detailed analysis of the bones and desiccated skin (when visible) and the CT scans suggests that the individuals were in an advanced state of skeletonization/mummification when the heads were removed. There are no cut marks on any of the visible bones, and there is generally a clean break at the articular facets at some point along the cervical spine such that several cervical vertebrae were removed with the skull while the remaining vertebrae were left behind. In the case of E82U, the skin of the neck broke at the level of C3–C4, while the cervical spine separated between C1 and the occiput. The hair mass was frequently left behind, indicating that decomposition had proceeded far enough that the scalp was no longer tightly bound to the cranium. The hair was apparently not of interest to the person who extracted the rest of the head.

Category 4 individuals

E68 is a nonadult burial, ca. seven to eight years of age, buried in an extended position, with a cream- and brown-colored cotton wrap, buried at a depth of 40 cm (Fig. 2). This is one of the fardos that had been exposed to water, so the bundle was conserved between our 2019 and 2022 seasons. As we could not visualize this individual directly, this description incorporates observations from the CT scan and notes by Shigwekawa (2021). E68 is part of a group burial including E69 to E74, all buried in an extended, supine position. There are no artifacts visible on the CT scan. This individual's calibrated median probability ^{14}C date is 1448 A.D. (2 sigma [σ] range = 1435 A.D. to 1460 A.D.), which places them in the Late Intermediate Period/Ychsma cultural phase.

This individual is one of only two nonadult burials older than the age of three years to be positioned in the extended position in the Sector 3 sample. The other is E70, part of this group burial along with the extended adult E69 (see below). Jijon y Caamaño (1949) first noted that the youngest individuals (age less than three to five years) on the Peruvian coast tended to be buried in the extended position from the Early



Figure 2. E68—Average Intensity Projection showing the extended position and lack of head.

Intermediate Period to the Late Horizon, while from the Middle Horizon (600 A.D. to 1000 A.D.), older nonadults and adults were generally buried in the seated flexed position. This change in position may reflect a change in social identity, possibly the attainment of personhood (Poeta and Nelson 2021). Baldeos (2015) believed that the burial pattern and textiles of this burial group did not correspond with typical Ychsma burials and suggested that they may be Inca in date. However, burial position is not the focus of this study and will be discussed elsewhere.

Baldeos (2015) described the head as being removed through a cut in the textiles. The cranium, mandible, and all cervical vertebrae are missing. The thoracic vertebrae, clavicles, and right scapula are displaced laterally. The left scapula and humerus are missing, and the right arm is displaced distally. The packing that

typically lies on top of the head in these fardos is intact and the opening in the wrappings for the removal of the head is where the face would have been, which is in keeping with the extended supine position. The damage to the thorax was quite extensive in comparison to the other fardos. No attempt was made to replace the wrappings.

Entomological analysis did not yield any information relevant to the mortuary treatment of this individual.

E69 is part of the same burial group as E68 (described above) and is a young adult male, buried at a depth of 30 cm (Fig. 3). This individual is the only adult in this cemetery to be buried in an extended position. This fardo was also exposed to moisture and was conserved in 2021, so as above, we are relying on



Figure 3. E69—Coronal CT slice showing the extended position and lack of head. The right-pointing arrow is highlighting the spondylus shell and the left-pointing arrow is highlighting the round metal artifacts.

notes from Shigwekawa (2021) and the CT scan. This individual had a half spondylus shell and a cluster of small metal circular artifacts located in the area of the chest. The calibrated median probability ^{14}C date is 1455 A.D. (2σ range = 1441 A.D. to 1485 A.D.). This date places this individual in the Late Intermediate Period/Ychsma cultural phase or possibly the Late Horizon/Inca cultural phase. Baldeos (2015) suggested that the textiles used to wrap this individual did not follow a typical Ychsma style, leading him to suggest that this individual might date to the Inca Period.

Like E68, the removal of the head was accompanied by considerable disturbance of the thorax, including the removal of all cervical vertebrae, the right humerus, clavicle and scapula, and inferior displacement of the left arm. The bulk of the original wrapping around the head has been displaced, and the head was removed through an opening in the wrappings where the face would have been. The displaced wrappings were folded back to roughly close the opening, but no attempt was made to hold them in place or to cover the opening. This is visible in the photographs taken at excavation (Baldeos 2015:226). Baldeos (2015) believed that this burial had been disturbed by sand mining or other modern activities.

Entomological analysis did not yield any information relevant to the mortuary treatment of this individual.

The fact that this individual had a spondylus shell and metal artifacts in the region of the chest/head suggests that this interference was unlikely to have been from a modern looter, who would likely have been more interested in the artifacts than the skull. However, in keeping with the Category 4/5 distinction, we will be conservative in our interpretation.

E76A is a young adult male, buried at a depth of 120 cm, in a seated and flexed position (Fig. 4). The fardo contains numerous metal foil fragments (at least two of copper), and the bundle is wrapped in a cotton cream and brown textile. This individual is one of a group of burials (E76A to E76H). The calibrated median probability ^{14}C date is 1433 A.D. (2σ range = 1417 A.D. to 1449 A.D.). This date places this individual in the Late Intermediate Period/Ychsma cultural phase.

The skull and first four cervical vertebrae were removed. The textiles around the head end of the fardo included a textile wrapping the neck, one over the body of the fardo, and one over the head end that overlays the body shroud over the shoulders. All three textiles were damaged in order to access the head. No attempt was made to repair or reorganize the textiles.

Entomological analysis demonstrates that the life cycle of *Synthesiomyia nudiseta* (Muscidae) was complete, suggesting that the individual was exposed for an extended period of time, possibly three to four weeks,

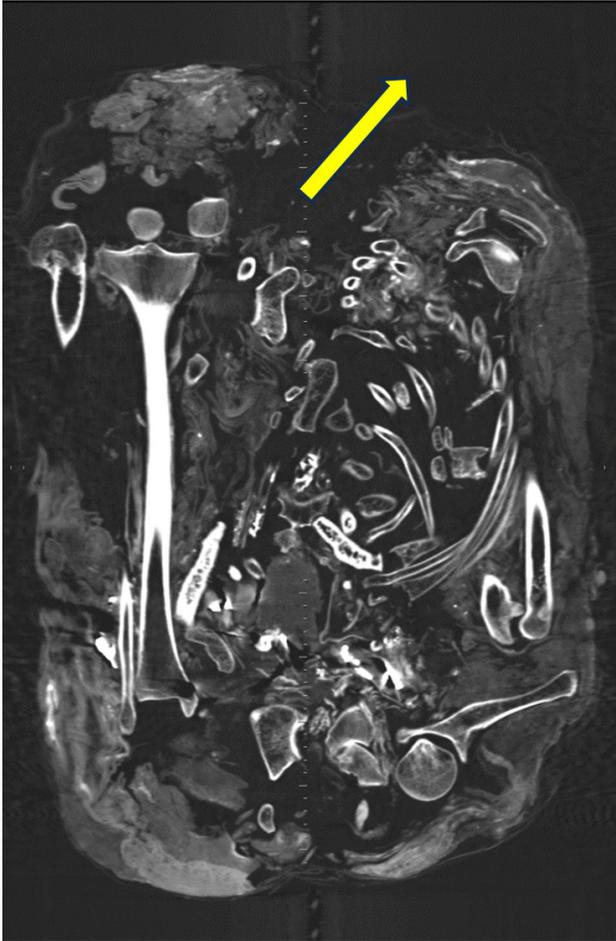


Figure 4. E76A—Coronal CT slice. Note the channel (arrow) left by the removal of the head and neck.

between death and burial. Given the skeletonized/mummified state that the neck must have been in at the time of removal, three to four weeks is not likely enough time for soft tissue desiccation to proceed far enough to allow the head to be removed before it was buried. The coastal desert can be quite hot during the summer months of February and March, with very little precipitation but with high humidity (Aliaga-Nestares et al. 2023). Galloway (1997) has reported that a corpse may become mummified in as few as 11 days in the Sonoran Desert, but humidity in Arizona is much lower than it is on the Central Coast. Once buried, it is not clear how long it would take for a human body to attain the state of skeletonization/mummification observed here. Janaway et al. (2009) used pigs as body analogs to suggest that a body buried in an open tomb on the Peruvian coast can retain a moist core for up to two years, although the extremities were desiccated by then.

This individual was a deep burial and is therefore less likely to have been encountered by modern

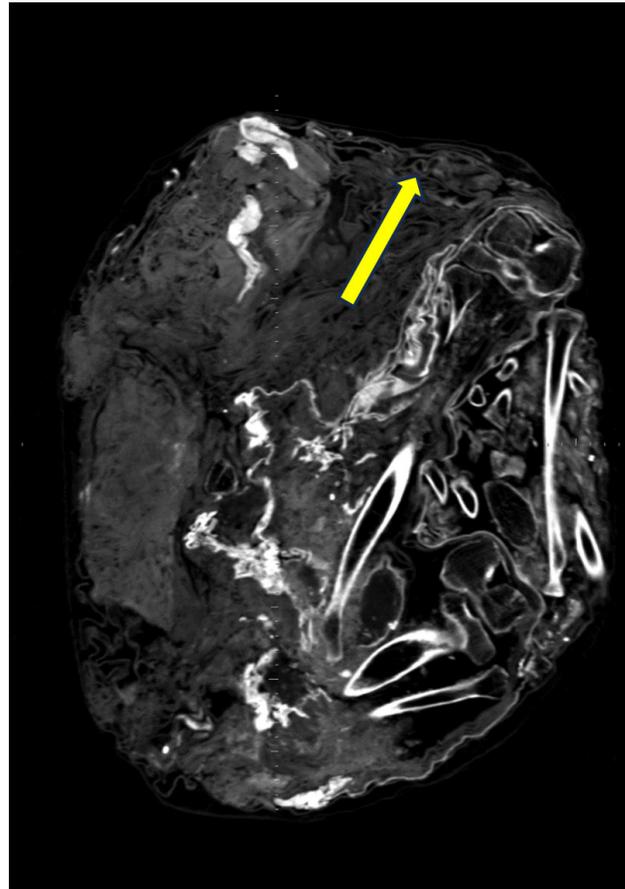


Figure 5. E76D—Coronal CT slice. Note the channel (arrow) left by the removal of the head and neck.

looters. However, in keeping with the Category 4/5 distinction, we will be conservative in our interpretation.

Category 5 individuals

E76D is part of the same group of burials as E76A, discussed above. This individual is a young to middle adult female, buried in a seated, flexed position at a depth of 120 cm (Fig. 5). The bundle contained numerous spindles (Fig. 6), spindle whorls (not seen in the figures), and associated threads, and was wrapped by a beige plain-weave textile. There is no ^{14}C date for this individual.

A coronal CT slice through the fardo (Fig. 5) shows quite a broad area of disturbance that includes the displacement of ribs and removal of all cervical and many thoracic vertebrae. After removal, textiles were used to pack the void, and a red tight weave textile was placed over the opening and a large beige plain textile was used to rewrap the whole bundle. This textile was kept in place by belts wrapped around the middle of the fardo (Fig. 6).

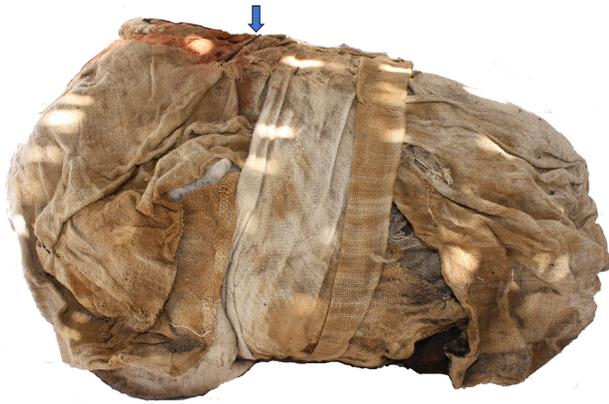


Figure 6. E76D—Photo of the fardo (photo: Andrew Nelson). Note the intact outer wrapping and the belt around the middle of the fardo. The head end of the fardo is to the left side of the image. A single spindle (one of several) can be seen as indicated by the arrow.

The entomological analysis suggests that this individual was likely buried quickly after their death, based on the absence of the remains of pioneer fly species (Calliphoridae).

E82A is a young adult male, buried in a seated, flexed position at a depth of 75 cm (Fig. 7). E82A is part of an extensive deposit of 24 fardos, buried in close association. There are a number of metal artifacts (mostly small foils and two large objects) inside the fardo. Abundant raw cotton without seeds was used to stuff the fardo. The calibrated median probability ^{14}C date is 1342 A.D. (2σ range = 1315 A.D. to 1360 A.D.). This date places this individual in the Late Intermediate Period/Ychsma cultural phase.

The removal of the head appears to have taken most of the cervical vertebrae and displaced several thoracic vertebrae and the scapulae. The displaced textiles were folded back to close the opening. The bundle appears to be intact in the excavation photo (Baldeos 2015:293), enough so that Baldeos commented on cotton being placed “sobre la cabeza” (2015:293) (“over the head”).

The entomological analysis suggests that this individual was likely buried quickly after death, based on the absence of pioneer fly species.

E82H is a young adult female, buried in a seated flexed position at a depth of 120 cm, and it is part of the E82 group burial. Abundant raw cotton with seeds was used to stuff the fardo and there are nectandra seeds, several small metal foils, and a large unidentified metal artifact in the fardo (a square metal foil ca. $10 \times 6.5\text{cm}$) (Fig. 8). The calibrated median probability ^{14}C date is 1394 A.D. (2σ range = 1389 A.D. to 1413 A.D.). This date places this individual in the Late Intermediate Period/Ychsma cultural phase.

This individual’s head was removed, taking all cervical and possibly the top thoracic vertebrae. The

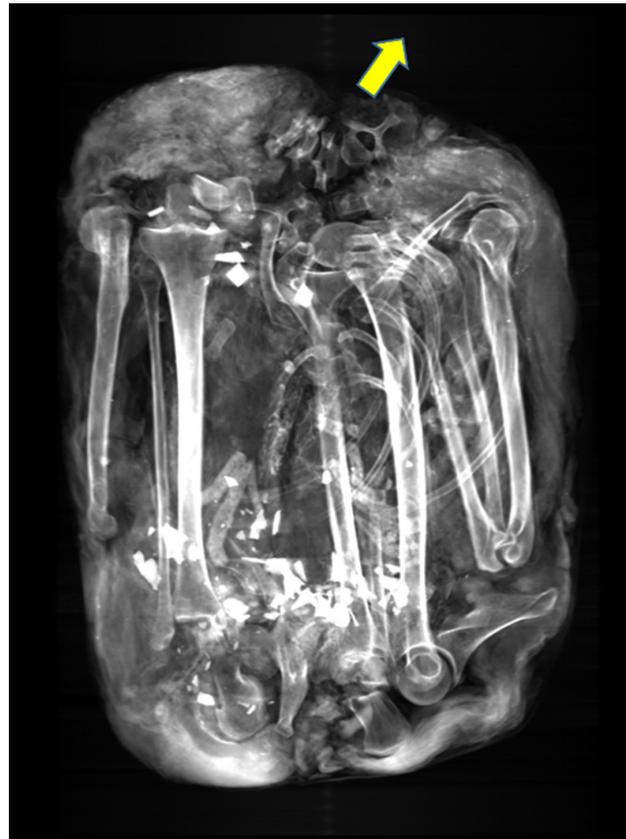


Figure 7. E82A—Coronal CT slice. Note the presence of the metal foils. The arrow indicates the position of loose vertebrae and the break in the textile through which the head was removed.

surrounding textiles were carefully rearranged after removal, including placing a light brown, blue-striped Ychsma textile over the opening where the head had been. It is unclear whether this textile is an original element of the fardo used to cover the opening or whether it was added for the purpose of recovering the opening, but it covers most of the fardo.

The entomological analysis identified 28 hatched puparia and two complete puparia of Calliphoridae in various parts of the fardo. This suggests that the fardo was exposed for 10 to 15 days, corresponding to the early part of the immature life cycle of these flies (depending on local temperatures).

E82T is an old adult male, buried in a seated flexed position at a depth of 110 cm as part of the E82 group burial. There are several metal foils visible on the X-ray (Fig. 9). The fardo also contains a bundle of cane tubes (Fig. 9), a sling, and several corncobs (not visible in Fig. 9). The calibrated median probability ^{14}C date is 1342 A.D. (2σ range = 1315 A.D. to 1360 A.D.). This date places this individual in the Late Intermediate Period/Ychsma cultural phase.

The removal of the head of this individual caused considerable disturbance of the thorax. It displaced the ribs and right humerus laterally and removed all



Figure 8. E82H—Coronal CT slice. Note the channel (arrow) left by the removal of the head and neck. The circle indicates the location of the unidentified metal artifact.

the cervical and most of the thoracic vertebrae and the right scapula and clavicle. After removal of the head, the opening was covered by a brown gauze textile decorated with beige circles. This was likely the original outermost shroud, displaced for the removal of the head and then returned to its position. The shroud was held in place by a coarse weave textile belt around the middle of the fardo.

Entomological analysis suggests that burial of this individual took place rapidly after death on the basis of a lack of remains of pioneer flies.

E82U is a middle to old adult female, buried in a seated, flexed position at a depth of 110 cm, buried adjacent to E82W (below) as part of the E82 group burial. Openings in the wrappings show both hands, which



Figure 9. E82T—Coronal CT slice. Note the presence of the metal foils and the cane tubes (circled). The channel left by the removal of the head and neck is indicated by the arrow.

display geometric tattoos. The bundle contains abundant raw cotton with seeds, a nectandra seed necklace, spinning spindles near the hands, small feathers, and a silver foil near the neck and another foil by the left elbow (Fig. 10). The calibrated median probability ^{14}C date is 1346 A.D. (2σ range = 1301 A.D. to 1363 A.D.). This date places this individual in the Late Intermediate Period/Ychsma cultural phase.

The outermost wrapping is a cream-colored plain-weave textile that appears to have been cut for the removal of the head. A block of cervical vertebrae with accompanying skin and connective tissue was broken away from C1 to C5 but remained in the fardo. The break in the skin of the neck appears at about C3–C4, while the C1 and occipital condyles separated at the point of articulation. This highlights the brittle nature of the desiccated tissue at the time of head removal. An internal textile was folded into the opening left from the removal of the head and a few stitches were used to hold it in place. A small textile, described by

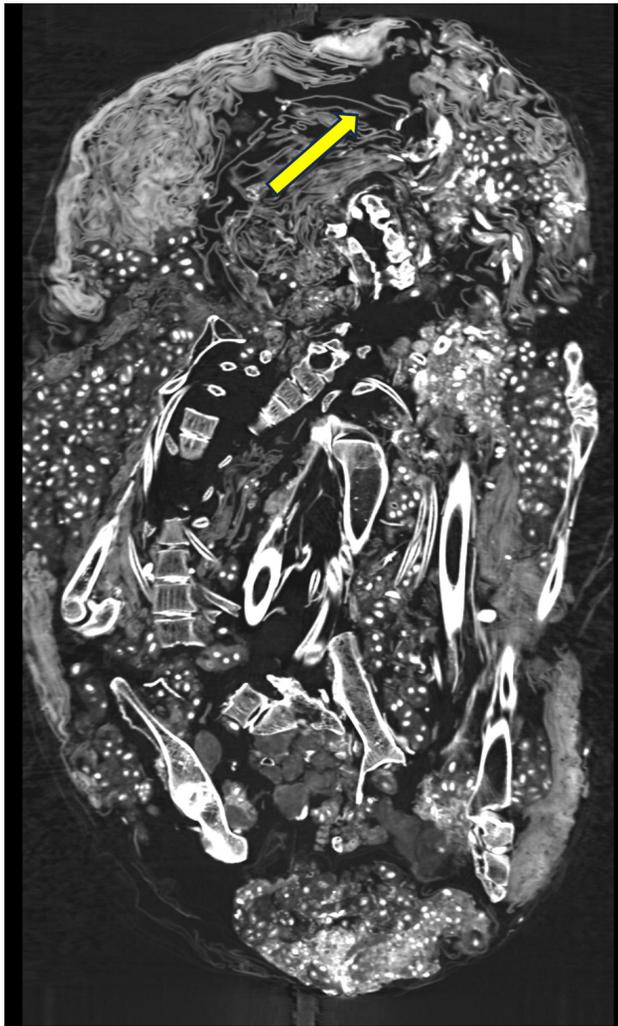


Figure 10. E82U—Coronal CT slice. Note the channel (arrow) left by the removal of the head and neck.

Baldeos (2015) as a rectangular tapestry measuring 40 × 45 cm, was used to cover where the head had been.

A few *Calliphoridae* puparia were noted, but all had hatched and no adult remains were encountered. This suggests that the body was exposed for less than 10 to 15 days before burial. The presence of late-arriving *Muscidae* flies, who feed on decomposition products, suggests that the burial was reopened and the head removed before the body was completely desiccated.

E82W is a young adult female, buried in a seated, flexed position at a depth of 75 cm, buried next to E82U (above) as part of the E82 group burial. The bundle was stuffed with abundant raw cotton with seeds and has a single wooden support pole (Fig. 11). No artifacts were visible on direct observation or on the X-ray. The calibrated median probability ¹⁴C date is 1420 A.D. (2σ range = 1404 A.D. to 1439 A.D.). This date places this individual in the Late Intermediate Period/Ychsma cultural phase.



Figure 11. E82W—Composite X-ray. The support pole is indicated by the arrow.

The beige textile originally covering the head had been displaced sideways to the individual's left to create the opening to access the head. The head was then removed, taking the cervical vertebrae and disturbing the thorax and both shoulder girdles. The hair mass was left behind. The textile was then folded back into place and fixed by a few stitches (Fig. 12a and 12b).

A few *Calliphoridae* puparia were noted in the outer folds of the bundle's textiles, but they had hatched and no adult remains were encountered. This suggests that the body was exposed for up to 10 to 15 days before burial.

Discussion

The practice of repairing the opening and/or rewrapping the fardo strongly suggests that the removal of the head in these cases was not an act of violence or looting. This conclusion is consistent with the practice of head recovery reflecting the reverence for the ancestors discussed by Carmichael (1994), Arnold and



Figure 12. E82W—Figure 12a is the general view of the textile covering the opening through which the head had been removed. Figure 12b shows the stitching of that textile to surrounding wrappings (the wrappings were folded back to allow this view). An arrow indicates the location of the stitches. Photos: Andrew Nelson.

Hasdorf (2008), and Toyne (2015). However, the degree of damage to the upper half of the spine and thorax in several cases suggests that it was not a delicate process. The process of preparing these individuals for wrapping and burial was not necessarily delicate either (e.g., the positioning of the legs was often accompanied by the dislocation of the hip). The process of decomposition often led to bones moving out of position (particularly of the trunk, where decomposition would begin), but the frequent removal of cervical and thoracic vertebrae and often other elements of the shoulder girdle suggests that this particular pattern is associated with the deliberate removal of the head rather than postmortem decomposition.

The sample of six Category 5 individuals includes four females and two males, and they range in age from young adults to old adults. The general lack of burial goods and the simple nature of the burial goods that did accompany some of these individuals suggest that they were of modest status. Thus, apart from them being adults, there does not appear to be a specific identity (age, sex, status) that the individuals gathering

the heads had in mind when they chose a fardo to sample.

The ^{14}C dates (all dates in text are calibrated) shown in Table 3 demonstrate that the cemetery was in use for ca. 200 years (E64 to E71), with most burials taking place in the Late Intermediate Period and three (E69, E71, and E76C) bridging (with their 2σ ranges) the end of the Late Intermediate Period and the early years of the Late Horizon. These dates correspond to the Middle and Late Ychsma and/or Inca cultural periods. A burial's depth in the cemetery is not correlated with the date of burial, particularly in the case of E64, the highest fardo in the cemetery, who has the earliest date (1295 A.D.). The five Category 5 individuals for whom we have ^{14}C dates date to 1420 A.D. or earlier, and the three Category 4 individuals date between 1433 A.D. and 1455 A.D. However, overlapping 2σ ranges of E82W and E76A preclude making a clear temporal distinction between the two groups. The fact that E69 has a spondylus shell and metal artifacts suggests that it is unlikely that a modern looter, who would probably have been more interested in the artifacts than the head, defiled this individual. However, for the sake of maintaining a conservative approach, we can conclude that the practice of retrieving heads and repairing the bundles took place in the first two-thirds of the use of the cemetery.

The dates for the group burials also shed important light on how the cemetery was used. The individuals who comprise the group burials do not appear to have been deposited at the same time. E88 and E88B were uncovered immediately adjacent to each other (E88A was on the other side of E88), and this group burial is the deepest in the cemetery. However, E88A yielded a date of 1397 A.D. (2σ 1390–1415 A.D.) while E88 was dated to 1448 A.D. (2σ 1435–1460 A.D.). Similarly, E76A dates to 1433 A.D. (2σ 1417–1449 A.D.) while E76C dates to 1475 A.D. (2σ 1452–1501 A.D.). In both cases, the 2σ values do not overlap, suggesting the burial events took place at different times. The larger group burials E82 and the extended group (E68 to E73) show lengthy deposition sequences of 84 and 54 years, respectively, with no overlap between the earliest and latest 2σ ranges. Thus, it is quite likely that these are not group burials in the sense of a single burial event. Rather, either purposefully or accidentally, serial burial events happened to place new individuals in close proximity to individuals who had previously been interred. The lack of bleaching and overall preservation of the fardos suggest that they must have been covered over by sand in the intervening years.

Several of the burials described here have entomological evidence suggesting that they were buried between a few days and a few weeks after death. Motley's (2022) taphonomic analysis of the completeness and

Table 3. C-14 dates for the Sector 3 Cemetery

Keck Lab #	Universit�		F ¹⁴ C	D ¹⁴ C (‰) ±	Context	Sex	Age	depth	¹⁴ C age (BP) ±	calibrated median probability date (AD)			Other Comment	
	Laval #	LA								-2 sigma (AD)	+2 sigma (AD)			
UCIAMS-277504	ULA-I1076	0.912	0.0015	-88	1.5	E64	undetermined	20	740	15	1295	1278	1313	highest in cemetery
UCIAMS-277534	ULA-I1099	0.9422	0.0016	-57.8	1.6	E68	undetermined	40	480	15	1448	1435	1460	E68-74 group burial
UCIAMS-277535	ULA-I1100	0.9445	0.0015	-55.5	1.6	E69	male	40	460	15	1455	1441	1485	E68-74 group burial
UCIAMS-277536	ULA-I1101	0.9429	0.0015	-57.1	1.5	E70	undetermined	40	470	15	1451	1438	1462	E68-74 group burial
UCIAMS-277505	ULA-I1077	0.9502	0.0016	-49.8	1.6	E71	undetermined	40	410	15	1493	1456	1508	E68-74 group burial
UCIAMS-277507	ULA-I1078	0.9384	0.0016	-61.6	1.7	E72	undetermined	40	510	15	1439	1424	1453	E68-74 group burial
UCIAMS-277508	ULA-I1079	0.9391	0.0015	-60.9	1.5	E73	undetermined	40	505	15	1441	1427	1453	E68-74 group burial
UCIAMS-277509	ULA-I1080	0.9369	0.0015	-63.1	1.5	E76A	male	120	525	15	1433	1417	1449	E76 group burial
UCIAMS-277510	ULA-I1081	0.9472	0.0014	-52.8	1.4	E76C	undetermined	120	435	15	1475	1452	1501	E76 group burial
UCIAMS-277511	ULA-I1082	0.943	0.0014	-57	1.4	E78	undetermined	120	470	15	1451	1438	1462	E68-74 group burial
UCIAMS-277512	ULA-I1083	0.9224	0.0015	-77.6	1.5	E82A	undetermined	70	650	15	1342	1315	1360	E82 group burial
UCIAMS-277520	ULA-I1086	0.9348	0.0014	-65.2	1.4	E82C	male	120	540	15	1426	1389	1443	E82 group burial
UCIAMS-277522	ULA-I1087	0.9266	0.0015	-73.4	1.5	E82H	female	120	610	15	1394	1389	1413	E82 group burial
UCIAMS-277523	ULA-I1088	0.9344	0.0015	-65.6	1.5	E82L	undetermined	75	545	15	1424	1408	1442	E82 group burial
UCIAMS-277524	ULA-I1089	0.922	0.0015	-78	1.5	E82T	male	75	650	15	1342	1301	1363	E82 group burial
UCIAMS-277525	ULA-I1090	0.9203	0.0015	-79.7	1.5	E82U	female	75	665	15	1346	1301	1363	tattoos; E82 group burial
UCIAMS-277526	ULA-I1091	0.9334	0.0015	-66.6	1.5	E82W	female	75	555	15	1420	1404	1439	E82 group burial
UCIAMS-277527	ULA-I1092	0.9398	0.0015	-60.2	1.5	E84	male	100	500	15	1443	1429	1454	atypical burial
UCIAMS-277528	ULA-I1093	0.9418	0.0015	-58.2	1.5	E88	undetermined	140	480	15	1448	1435	1460	deepest in cemetery; E88 group burial
UCIAMS-277529	ULA-I1094	0.9272	0.0013	-72.8	1.3	E88B	undetermined	140	605	15	1397	1390	1415	deepest in cemetery; E88 group burial
UCIAMS-277530	ULA-I1095	0.9357	0.0014	-64.3	1.4	Fardo 1	(female)	20	535	15	1429	1412	1445	associated with an arribaloid
UCIAMS-277531	ULA-I1096	0.9356	0.0015	-64.4	1.5	Fardo 9	male	20	535	15	1429	1412	1445	distinctive metal artifact

shaded rows represent headless individuals

articulation of the skeletons is consistent with this model. Most of these burials display hyperflexed limbs. Recent experimental research by Schotsman et al. (2022) demonstrates that hyperflexion can be achieved after the cessation of rigor mortis. Estimates for the duration of rigor mortis vary between 24 and 84 hours after death (Goff 2009) and 44 and 76 hours after death (Krompecher 2015). Goff (2009) notes that low temperatures can prolong rigor while higher temperatures can reduce its length. A delay between death and burial is also consistent with various Spanish chronicles, which describe a delayed mortuary ritual of approximately five to 10 days (depending on the source: e.g., Cieza de Leon [1553] 1922:220; the Huarochiri manuscript Avila [1573–1647] 1991:129; and Guaman Poma [1615] 2009:226–228). However, given the prevailing environmental conditions on the Central Coast of Peru, particularly in terms of temperature and humidity, it is unlikely that this period was long enough for mummification/skeletonization to proceed to the state where the skin and intervertebral (and other) joints were brittle enough to break cleanly and for the hair mass to be separated from the cranium. It is therefore likely that the individuals were buried after an initial delay but then revisited at a later date to retrieve the head.

Other examples of head removal are known from the Central Coast. These include three fardos from a large chamber tomb associated with the Painted Temple at Pachacamac (Takigami et al. 2014). This chamber was in use from ca. 1000 A.D. to 1500 A.D. During this time, the tomb was revisited regularly to inter new individuals. Takigami et al. (2014) suggest that it was likely that these heads were removed some time after burial, but no attempt was made to sew the wrappings back together. We scanned one of these fardos (along with four others from the chamber tomb) in 2021. The scan demonstrates a similar pattern of disturbance to the cervical vertebrae as the examples discussed here, but the wrappings around where the head would have been are largely missing and do not appear to have been repaired. This would correspond to a Category 4 fardo as defined here.

Beyond the site of Pachacamac, Jijón y Caamaño (1949) described several headless individuals from the nearby site of Maranga. Several of these date to the Early Intermediate Period. One headless fardo was recovered from Huaca II, Cemetery 4, dating to the Late Intermediate Period and so is contemporary with the material described here. One headless individual from the Jijón y Caamaño collection at the Pontificia Universidad Católica del Ecuador (JC-AP-2068) was examined and X-rayed by the project described in Ordoñez et al. (2015) (AN was a member of this project). The X-rays show that this individual is an extended

infant, less than one year old with no head, but with complete, intact wrappings around the head region of the fardo. Unfortunately, the concordance from the museum catalog numbers to the descriptions in Jijón y Caamaño's (1949) monograph has been lost, so we cannot be sure of its original context, but this infant likely dates to the Late Intermediate Period or Late Horizon.

Watson (2019) has described two headless Chancay individuals from the site of Ancón, located in the northern part of the Lima Province. The first individual, 2.5-165-IVCIIAA-94, an adult female, lacks the cranium and mandible but retains the atlas and axis. Watson (2019) suggested that if the head was removed intentionally, it would have been done when the body was skeletonized. Other postcranial elements were missing as well. The second individual, 2.5.197-ICCIIAA-94, an adult male individual, is also missing the cranium, mandible, and other skeletal elements. The fardo contains elements from additional adult and nonadult individuals. This individual is exceptional, as they are associated with an elaborate Late Horizon poncho that contains Chimú-Lambayeque iconography and Inca design elements. One panel of the poncho shows a figure featured elsewhere on the poncho, but in this instance, they are shown without a head. The narrative on the poncho appears to be the funeral of the headless individual, a noble ancestor from the North Coast. Watson (2019:112) allowed that the exact relationship between the textile and the deceased individual is not clear, although she noted that the association is unlikely to be accidental.

Slightly further afield, Carmichael (1988, 1994) described several instances of head removal from Early Intermediate Period Nazca burials, including one currently in the Field Museum whose head had been removed after the body was mummified (without cutting) (Carmichael 1988). He suggested that the heads were collected as a reference to collective ancestors who had "life giving powers of rejuvenation" (Carmichael 1994:84). Conlee (2007) presented a Middle Nazca headless burial from the site of La Tiza who did demonstrate cut marks on the third cervical vertebra. The photo of the burial (Conlee 2007:441) shows a skeleton in a good state of articulation, so it was possible that this individual's head was removed at the time of burial, representing a different pattern than that described here. DeLeonardis (2000) also described a Nasca headless burial from the site designated as PV62D13, and like the Conlee (2007) case, she concluded that the head was removed at the time of burial. Thus, it is possible that there might be at least two patterns of head retrieval in the Nasca culture, perhaps representing different processes and motivations.

Conclusions

The conclusions reached here emphasize the value of nondestructive paleoradiographic imaging done in conjunction with careful direct observations and minimally invasive archaeometric methods to survey large numbers of fardos. If these fardos had been unwrapped before X-raying, it is quite likely that subtle details of the wrapping and stitching would have been missed, making it difficult to reconstruct the full sequence of events.

Individuals buried in the Sector 3 cemetery demonstrate varying degrees of delayed mortuary ritual, followed by burial at varying depths in the sandy matrix. At least six, and possibly more, individuals from this sample demonstrate the removal of the head from a fardo after it had been buried, and decomposition had proceeded far enough for the head to come away from the spine and hair mass, with some effort made to repair or restore the wrappings after they had been opened. This would be consistent with the removal of the head for the purposes of ancestor veneration as described by Carmichael (1988, 1994), rather than decapitating an enemy or looting the burial.

The Sector 3 cemetery was in use from the late thirteenth century A.D. to the latter half of the fifteenth century A.D., during which a minimum of 88 funerary bundles and many other funerary contexts (poorly preserved fardos, secondary burials, or bone offerings) were buried. The deceased individuals were being exposed for various lengths of time from a few days to a few weeks. This suggests a dynamic cycle of mortuary activity, with this sandy matrix cemetery being in a constant state of flux. During this time, new individuals were interred alongside earlier burials, creating what now appear to be groups of burials and allowing access to earlier bundles for the retrieval of heads. The headless fardos do not fit any kind of demographic profile, beyond being adults, that suggests that the “decapitators” had a particular identity or phenotype (e.g., age or sex profile) in mind when they harvested a skull (cf. Toyne 2015). This model could also explain why the preponderance of the headless fardos are early in the cemetery’s use, as they would have been encountered during later burial events.

Ultimately, we do not know for sure why these heads were removed. Verano (1994) and Tung (2007) (*inter alia*) have described isolated deposits of human head in many Pre-Hispanic cultures, and the practice of trophy head collection among the Nasca, so while the practice was certainly common, its motivations differed. Further work on this topic will require detailed analysis of isolated deposits of human bone at Pachacamac and other sites on the Central Coast.

The overall picture outlined here suggests that the complex mortuary ritual that was practiced among individuals of modest status on the fringes of an important pilgrimage and administrative center was not markedly different from what was going on in the large chamber tomb located in the center of the sanctuary, in terms of revisiting the tomb or cemetery and manipulating the earlier fardos (Takigami et al. 2014). Furthermore, this practice of head removal is in keeping with what is observed at earlier and contemporary sites on the Central Coast (Maranga [Jijón y Caamaño 1949]; Ancón [Watson 2019]) and in the nearby Nasca Valley (e.g., Carmichael 1988, 1994), and it differs from the more violent decapitation of the enemy practiced frequently elsewhere in the Central Andes (e.g., North Coast [Cordy Collins 2001] and Wari [e.g., Tung 2008]). Further work by the Mummies as Microcosms Project will seek to see how widespread this practice was on Peru’s Central Coast.

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Ethics Statement

The project has received ethics approval from the University of Western Ontario's Human Subjects Research Ethics Board, Project ID: 114146, granted June 10, 2019, and renewed annually. This is a collaborative effort between the Mummies as Microcosms Project and Museo Pachacamac and the samples were exported under permit from the Ministry of Culture. The fundamental approach of the project is to use nondestructive methods to image the contents of these funerary bundles, and to use minimally invasive sampling techniques to obtain samples for ¹⁴C and isotopic analysis. We recognize that these funerary bundles contain the remains of people who once lived, loved, and died, and as such they demand our respect.

References

- Aliaga-Nestares, Vannia, Gustavo de la Cruz, and Ken Takahashi. 2023. Comparison between the operational and statistical daily maximum and minimum temperature forecasts on the Central Coast of Peru. *Weather and Forecasting* 38:555–570.
- Arnold, Denise Y., and Christine A. Hasdorf. 2008. *Heads of State: Icons, Power, and Politics in the Ancient and Modern Andes*. Left Coast Press, Walnut Creek, CA.
- Avila, Francisco, de. [1573–1647] 1991. *The Huarochiri Manuscript: A Testament of Ancient and Colonial Andean Religion*. University of Texas Press, Austin.
- Baldeos Terrones, Jhon A. 2015. *Proyecto de Rescate Arqueológico en el Sitio Monumental de Pachacamac—Sector 3. Informe de Proyecto de Rescate Arqueológico para la Construcción del Museo Nacional del Perú "MUNA"*. Informe prepared for the Ministry of Culture, Lima, Peru.
- Betanzos, Juan 1996 [1576]. *Narrative of the Incas*. Translated and edited by Roland Hamilton and Dana Buchanan from the Palma de Mallorca manuscript. University of Texas Press, Austin.
- Buikstra, Jane E., and Douglas H. Ubelaker, eds. 1994. *Standards for Data Collection from Human Skeletal Remains*. Arkansas Archeological Survey, Fayetteville.
- Carmichael, Patrick H. 1988. *Nasca Mortuary Customs: Death and Ancient Society on the South Coast of Peru*. Doctoral Dissertation. Department of Archaeology, University of Calgary. University Microfilms International, Ann Arbor, MI, Number 8918465.
- Carmichael, Patrick H. 1994. The life from death continuum in Nasca imagery. *Andean Past* 4:81–90. https://digitalcommons.library.umaine.edu/andean_past/vol4/iss1/9
- Carmichael, Patrick H. 1995. Nasca burial patterns: Social structures and mortuary ideology. In *Tombs for the Living: Andean Mortuary Practices*, edited by Tom Dilehay. Dumbarton Oaks, Washington, D.C., pp. 161–187.
- Cieza de Leon, Pedro. [1553] 1922. *La Crónica del Perú*. Calpe, Madrid.
- Conlee, Christina A. 2007. Decapitation and rebirth a headless burial from Nasca, Peru. *Current Anthropology* 48:438–445. DOI: 10.1086/517591
- Conlogue, Gerald J. 2020 Case study 1: Large objects. In *Case Studies for Advances in Paleoimaging and Other Non-Clinical Applications*, edited by Ron G. Beckett, Gerald J. Conlogue, and Andrew J. Nelson. Taylor & Francis, CRC Press, Boca Raton, FL, pp. 1–12.
- Cordy-Collins, Alana. 2001. Decapitation in Cupisnique and Moche societies. In *Ritual Sacrifice in Ancient Peru*, edited by Elisabeth P. Benson and Anita G. Cook. University of Texas Press, Austin, pp. 21–34.
- DeLeonidis, Lisa. 2000. The body context: Interpreting Early Nasca burials. *Latin American Antiquity* 11:3636–3686. <https://www.jstor.org/stable/972002>
- Diaz Arriola, Luisa E. 2015. The preparation of corpses and mummy bundles in Ychsma funerary practices at Armatambo. In *Funerary Patterns and Models in the Ancient Andes: The Return of the Living Dead*, edited by Peter A. Eeckhout and Lawrence S. Owens. Cambridge University Press, Cambridge, pp. 186–209.
- Eeckhout, Peter. 2004. Reyes del sol y señores de la luna. Inkas e Ychsmas en Pachacámac. *Chungara, Revista de Antropología Chilena* 36:495–503.
- Efremov, Ivan A. 1940. Taphonomy: A new branch of paleontology. *Pan American Geologist* 74:81–93.
- Frame, Mary, and Rommell A. Falcón. 2014. A female funerary bundle from Huaca Malena. *Ñawpa Pacha* 34(1):27–59. DOI: 10.1179/0077629714Z.00000000013
- Frame, M., F. Vallejo, M. Ruales, and W. Tosso. 2012. Ychsma textiles from a Late Horizon burial at Armatambo. *Ñawpa Pacha* 32(1):43–84. <https://doi.org/10.1179/naw.2012.32.1.43>
- Frame, Mary, Daniel Guerrero Zevallos, María Carmen Vega Dulanto, and Patricia Landa Cragg. 2004. Un fardo funerario del Horizonte Tardío del sitio Rinconada Alta, valle del Rímac. *Bulletin de l'Institut Français d'Études Andines* 33(3):815–860. DOI: 10.4000/bifea.5377
- Fuentes, Sarita, Denise Pozzi-Escot, Lucía Watson, and Andrew J. Nelson. 2022. The city of the living and the dead: Bioarchaeology and our understanding of the site of Pachacamac, Peru—120 years of history. Paper presented at the 10th World Congress on Mummy Studies, Bolzano, Italy.
- Galloway, Alison. 1997. The process of decomposition: A model from the Arizona–Sonoran Desert. In *Forensic Taphonomy*, edited by William D. Haglund and Marcella H. Sorg. CRC Press, Boca Raton, FL, pp. 139–150.

- García Salcedo, Sara, and Jhon Baldeos Terrones. 2020. *Informe Final Plan de Monitoreo Arqueológico para la Creación del Museo Nacional Del Perú (MUNA), Distrito De Lurín, Provincia y Departamento de Lima. Autorizado Con Rd N° 109-2016/Dce/Dgpa/Vmpcic/Mc*. Informe prepared for the Ministry of Culture, Lima, Peru.
- Giordani, Giorgia, Andrzej Grzywacz, and Stefano Vanin. 2018. Characterization and identification of puparia of *Hydrotaea Robineau-Desvoidy*, 1830 (Diptera: Muscidae) from forensic and archaeological contexts. *Journal of Medical Entomology* 56:45–54. DOI: 10.1093/jme/tjy142
- Goff, M. Lee. 2009. Early post-mortem changes and stages of decomposition in exposed cadavers. *Experimental and Applied Acarology* 49:21–36. DOI: 10.1007/s10493-009-9284-9
- Greenberg, Bernard, and Michael L. Szyska. 1984. Immature stages and biology of fifteen species of Peruvian Calliphoridae (Diptera). *Annals of the Entomological Society of America* 77:488–517. DOI: 10.1093/aesa/77.5.488
- Guaman Poma de Ayala, Francisco. [1615] 2009. *The First New Chronicle and Good Government: On the History of the World and the Incas up to 1615*. University of Texas Press, Austin.
- Hogg, Aala G., Timothy J. Heaton, Quan Hua, Jonathan G. Palmer, Chris S. M. Turney, John Southon, et al. 2020. SHCal20 Southern Hemisphere calibration, 0–55,000 years cal BP. *Radiocarbon* 62:759–778. DOI: 10.1017/RDC.2020.59
- Huchet, Jean-Bernard. 2014. L'archéontologie funéraire. In *Insectes, cadavres et scènes de crime, Principes et applications de l'entomologie médico-légale*, edited by Damien Charabidze and Matthias Gosselin. De Boeck, Brussels, pp. 201–204.
- Huchet, Jean-Bernard, and Bernard Greenberg. 2010. Flies, Mochicas and burial practices: A case study from Huaca de la Luna, Peru. *Journal of Archaeological Science* 37:2846–2856. DOI: 10.1016/j.jas.2010.06.025
- Janaway, Robert C., Andrew S. Wilson, Gerardo Carpio Díaz, and Sonia Guillen. 2009. Taphonomic changes to the buried body in arid environments: An experimental case study in Peru. In *Criminal and Environmental Soil Forensics*, edited by Karl Ritz, Lorna Dawson, and David Miller. Springer, Dordrecht, pp. 341–356. DOI: 10.1007/978-1-4020-9204-6_22
- Jijon y Caamaño, J. 1949. *Maranga: Contribución al Conocimiento de los Aborígenes del Valle del Rimac, Perú*. La Prensa Católica, Quito.
- Knüsel, Christopher J., and John Robb. 2016. Funerary taphonomy: An overview of goals and methods. *Journal of Archaeological Science: Reports* 10:655–673. DOI: 10.1016/j.jasrep.2016.05.031
- Krompecher, Thomas. 2015. Rigor mortis: Estimation of the time since death by evaluation of cadaveric rigidity. In *Estimation of the Time Since Death*, 3rd ed., edited by Burkhard Madea. CRC Press, London, pp. 41–57.
- Löwenberg-Neto, Peter, and Claudio J. J. De Carvalho. 2013. Muscidae (Insecta: Diptera) of Latin America and the Caribbean: Geographic distribution and check-list by country. *Zootaxa* 3650:1–147. DOI: 10.11646/zootaxa.3650.1.1
- Marsh, Erik J., Maria C. Bruno, Sherilyn C. Fritz, Paul Baker, José M. Capriles, and Christine A. Hastorf. 2018. IntCal, SHCal, or a mixed curve? Choosing a 14C calibration curve for archaeological and paleoenvironmental records from Tropical South America. *Radiocarbon* 60:925–940. DOI: 10.1017/RDC.2018.16
- Motley, Jo. 2022. *Transforming the Dead. The Taphonomy and Ritual Economy of Funerary Bundles on the Pre-Hispanic Central Coast of Peru (1000-1532 CE)*. Doctoral dissertation, School of Graduate and Postgraduate Studies, Western University. <https://ir.lib.uwo.ca/etd/8804/>
- Nelson, Andrew J., Lucía C. Watson, Jocelyn Williams, Suellen Gauld, Jo Motley, Lauren Poeta, et al. 2021. Análisis de los fardos funerarios de Pachacamac: Aplicación sistemática de rayos X y tomografía computarizada en un contexto arqueológico. In *Actas VI Congreso Nacional de Arqueología, Ministerio de Cultura*. Ministry of Culture, Lima, Perú, pp. 293–308.
- Ogburn, Dennis E. 2007. Human trophies in the Late Pre-Hispanic Andes. In *The Taking and Displaying of Human Body Parts as Trophies by Amerindians*, edited by Richard J. Cacon and David H. Dye, Interdisciplinary Contributions to Archaeology. Springer, Boston, MA, pp. 505–522. DOI: 10.1007/978-0-387-48303-0_19
- Ordoñez Alvarez, Maria P. 2019. *Unbundled. European Collecting of Andean Mummies 1850–1930*. Doctoral thesis, Faculty of Archaeology, University of Leiden, Netherlands. <https://scholarlypublications.universiteitleiden.nl/handle/1887/74403>
- Ordoñez Alvarez, María P., Ron Beckett, Andrew J. Nelson, and Gerald J. Conlogue. 2015. Paleoimagen y análisis bioantropológico de la colección Maranga del Museo Jacinto Jijón y Caamaño. *Antropologica: Cuadernos de Investigación* (Revista de la Escuela de Antropología|Pontificia Universidad Católica del Ecuador) No 15.
- Owens, Lawrence S., and Peter Eeckhout. 2015. Social bioarchaeology of the Cemetery I at Pachacamac. In *Funerary Practices and Models in the Ancient Andes. The Return of the Living Dead*, edited by Peter Eeckhout and Lawrence S. Owens. Cambridge University Press, New York, pp. 158–185.
- Owens, Lawrence S., and Peter Eeckhout. 2022. Why Pachacamac? When Pachacamac? Investigating theories of environmental, culture history and Late Horizon triggers for the development of the Ychsma capital. In *Unveiling Pachacamac: New Hypotheses for an Old Andean Sanctuary*, edited by Giancarlo Marcone. University Press of Florida, Gainesville, pp. 181–226.
- Palma Malaga, Martha R., and Kryszttof Makowski. 2019. Bioarchaeological evidence of care provided to a physically disabled individual from Pachacamac, Peru. *International Journal of Paleopathology* 25:139–149. DOI: 10.1016/j.ijpp.2018.08.002.
- Poeta, Lauren S., and Andrew J. Nelson. 2021. Age, disability and status: A case study in the expression of mortuary identity in Pre-Columbian Peru. Paper presented to the Canadian Association for Physical Anthropology, Hamilton, ON.
- Pozzi-Escot, Denise. 2010. *Arqueología de Lima. Pachacamac*. Cuadernos del Patrimonio Cultural. Instituto Nacional de Cultura, Lima, Perú.
- Pozzi-Escot, Denise. 2017. Un espacio sagrado milenario. In *Pachacamac. El Oráculo en el Horizonte Marino del Sol Poniente*, edited by Denise Pozzi-Escot, Luis Millones, and José Canziani Amico. Banco de Crédito del Perú, Lima, Peru, pp. 1–31.
- Pozzi-Escot, Denise, Rocío Villar, Sarita Fuentes, Crisbel Miranda, Alfredo Molina, and Jaime Urrutia. 2018. Resurgir de las cenizas. Un hallazgo excepcional en Pachacamac. *Lienzo* 39:181–209. <https://revistas.ulima.edu.pe/index.php/lienzo/article/view/2498>
- Schotsmans, Eline M. J., Patrice Georges-Zimmermann, Maiken Ueland, and B. Boyd. 2022. From flesh to bone: Building bridges between taphonomy, archaeoethnology and forensic science for a better understanding of mortuary practices. In *The Routledge Handbook of Archaeoethnology*, edited by Christopher Knüsel and Eline M. J. Schotsmans. Routledge, Abingdon, Oxon, pp. 501–541. DOI: 10.4324/9781351030625
- Shigwekawa, A. 2021. *Proyecto de Conservación de Once Fardos Funerarios Provenientes de la Colección del Museo de Sitio de*

- Pachacamac para su Estudio por Medio de CT Scan*. Unpublished informe on file with the Mummies as Microcosms Project.
- Sutherland, M. Linda. 2019. Use of computed tomography scanning in a 'virtual' bioarchaeology of care analysis of a Central Coast Peruvian mummy bundle. *International Journal of Paleopathology* 25:129–138. DOI: 10.1016/j.ijpp.2018.12.006
- Takigami, Mai K., Izumi Shimada, Rafael Segura, Sarah Muno, Hiroyuki Matsuzaki, Fuyuki Tokanai, et al. 2014. Assessing the chronology and rewrapping of funerary bundles at the Prehispanic religious center of Pachacamac, Peru. *Latin American Antiquity* 25:322–343. <https://www.jstor.org/stable/43187127>
- Toyne, J. Marla. 2015. The body sacrificed. *Journal of Religion and Violence* 3:137–172. <https://www.jstor.org/stable/26671454>
- Tung, Tiffany A. 2008. Dismembering bodies for display: A bioarchaeological study of trophy heads from the Wari site of Conchopata, Peru. *American Journal of Physical Anthropology* 136:294–308. DOI: 10.1002/ajpa.20812
- Tung, Tiffany A., and Kelly J. Knudson. 2008. Social identities and geographical origins of Wari trophy heads from Conchopata, Peru. *Current Anthropology* 49:915–925. DOI: 10.1086/591318
- Tung, Tiffany A., and Kelly J. Knudson. 2010. Childhood lost: Abductions, sacrifice, and trophy heads of children in the Wari Empire of the ancient Andes. *Latin American Antiquity* 21:44–66. DOI: 10.7183/1045-6635.21.1.44
- Uhle, Max. 1903. *Pachacamac. Report of the William Pepper, MD, LLD Peruvian Expedition of 1896*. University of Pennsylvania, Department of Anthropology, Philadelphia.
- Verano, John. 1995. Where do they Rest? The treatment of human offerings and trophies in Ancient Peru. In *Tombs for the Living: Andean Mortuary Practices*, edited by Tom Dillehay. Dumbarton Oaks, Washington, D.C., pp. 189–227.
- Vreeland, Jamie M. Jr. 1998. Mummies of Peru. In *Mummies, Disease and Ancient Cultures*, edited by Aiden E. Cockburn, Eve Cockburn, and Theodore A. Reymann. Cambridge University Press, New York, pp. 154–189.
- Watson Jiménez, Lucía C. 2019. *Los Fardos de Ancón-Perú (800d.C-1532d.C). Una Perspectiva Bioarqueológica de los Cambios Sociales en la Costa Central del Perú*. BAR Publishing, Oxford.
- Wink, Alexandra E. 2014. Pubic symphyseal age estimation from three-dimensional reconstructions of pelvic CT scans of live individuals. *Journal of Forensic Sciences* 59:696–702.