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MULTIDISCIPLINARY STUDY OF THE MUMMY OF THE ANCIENT EGYPTIAN DIGNITARY USAI (7TH CENTURY BC)

ABSTRACT: In this article we describe the multidisciplinary study of the mummy of the ancient Egyptian dignitary Usai, exhibited in the Egyptian Gallery of the Museo Civico Archeologico of the city of Bologna (Northern Italy). The mummy was subjected to CT scan analysis and the acquired images were examined in the light of contemporary medical knowledge and palaeopathological rationale. The results indicate that the mummy belonged to a male individual, with average age at death of 50 years, who suffered from a series of age-related conditions, none of which appears to have proved fatal for him. The embalming technique follows in the footsteps of previous data on evisceration but highlights a rarer form of incomplete excerebration through the orbits.

KEY WORDS: Mummy - Radiology - CT scan - Imaging - Palaeopathological - Ancient Egypt - Skeletal diseases

INTRODUCTION AND AIM

In this article we describe our comprehensive study of the mummy of Usai, son of Nekhet and Heriubastet (MCABo EG 1975) (Kminek-Szedlo 1895), belonging to the Egyptian collection of the Museo Civico Archeologico in Bologna. This mummy and two related coffins arrived in Bologna in 1861, via the testamentary bequest of the Bolognese painter Pelagio Palagi (1775–1860), who collected 3,109 Egyptian antiquities in total during his life. In 1831 he bought this funerary set from Giuseppe Nizzoli, chancellor of the Austrian consulate in Egypt from 1818 to 1828. The mummy and its coffins are listed in the catalogue of Nizzoli's collection, which was published in Alexandria (Egypt) in 1827 (Nizzoli 1827), making them available for sale. In chapter XVI, the author highlights the amazing iconography of Usai's coffins, an outer *qrsw*-type ('sarcophagus' in the ancient Egyptian language) and an inner anthropoid coffin (Giovetti, Picchi 2016), as well as the excellent state of preservation of the mummy inside, wrapped in fine yellow linen bandages

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and overlapped by a faience net with amulets. The provenance of this funerary set is said to be Theban, in Upper Egypt. A typological and stylistic analysis of Usai's coffins provided a first basis for dating this set to the late 25th – early 26th Dynasty, i.e. 7th century (Taylor 2003, Taylor 2018). The outer coffin is a rectangular *qrsw*-type, which is undecorated inside. The lid features two figures of jackal and an *akhem* falcon overlapped on an axial inscription; each side is decorated with a *kheker*-frieze as edge-border, two lines of text and a strip of images and texts representing the solar boat towered by deities before whom Usai is in adoration. The side panels of the lid have a central scene flanked by texts. As far as the side panels of the case are concerned, a line of text runs along their upper edge while a palace façade frieze runs along the base. On the long sides, columns of texts and figures of gods inside shrines are in sequence. The texts belong to the *Book of the Day* and *Book of the Night* (ancient Egyptian funerary texts used from the beginning of the New Kingdom, around 1539 BC). The short sides have respectively a figure of Isis and Nephtys flanked by inscriptions in columns. Inscriptions are also on the corner-pillars with *akhem* falcons on the top. The inner anthropoid coffin has an axial inscription in one column on the frontal body of the lid and a single line of inscription running around the exterior case wall in the centre of the field. The interior of the case is painted with the figure of the goddess Imentit, 'She of the West'. This funerary set, which is considered one of the main artworks of the Bologna collection, has been on the public display since 1871.

In 2017, it became necessary to clean and consolidate the mummy wrappings. The conservation project started as soon as a sudden worsening of the mummy's general condition was detected. The results of the diagnostic investigations, including radiocarbon dating, palaeoradiology (Computed Tomography including 3D virtual reconstructions), provided interesting information.

Prior to our investigation no published data had been available on this mummy, although some old and low-resolution X-rays in the museum's archives testify to the fact that in the past some examination took place, although it did not lead to any definitive study.

The goal of research was to shed light on the anthropological and palaeopathological aspects of this mummy, hence finally being able to complement previous historical and Egyptological knowledge, and reconstruct part of the biological history of this ancient individual, while the results of the restoration of the mummy will be published separately in a specialised archaeological publication (Oliva, Picchi 2021 in press).

MATERIALS AND METHODS

Relative chronological information based on the stylistic study of the coffins in which the mummy lied was complemented by ^{14}C dating of a wooden specimen taken from the anthropoid coffin and of a textile fragment taken from the internal bandaging of the back of the mummy free of any consolidation and contaminants. Following decontamination treatments (Ether-Acetone-Ether and the standard protocol Acid-Alkali-Acid) and the conversion of the extracted CO_2 into graphite (at 600°C by using H_2 as the reducing agent and iron powder as the catalyst), the two samples were dated through the radiocarbon dating by Accelerator Mass Spectrometry (AMS) technique at the ^{14}C-AMS beamline at the CEDAD (Center of Applied Physics, Dating and Diagnostics) of the University of Salento, using a 3MV HVEE Tandetron accelerator (Mod. 4130HC). The radiocarbon conventional age was calibrated into the corresponding calendar ages with the software OxCal 4.3.2 using the curve based on atmospheric data (D'Elia *et al.* 2004).

The mummy of Usai, still fully wrapped, was subjected to CT scan analysis in order to acquire information about its anatomical structures as standard in current mummy studies. CT scan was performed in the Radiological Department of the Sant'Orsola-Malpighi Hospital of the University of Bologna using using a 64-section multidetector CT scanner (Lightspeed VCT 64; GE Healthcare, Milwaukee, Wis). Two acquisitions were obtained, one extended to the full body (from the apex of the skull to the feet) by using the following parameters: 1.25-mm section thickness (reconstructed with a 1.25-mm effective thickness), pitch of 5.5, 120 kV and 300 mA. The second scan, only including the skull and cervical vertebrae, was obtained with 0.625 mm slice thickness. In the post-processing phase, 2D and 3D multiplanar reformation (sagittal, oblique and coronal) and volume rendering reconstructions were made (Chhem, Brothwell 2010, Galassi *et al.* 2020).

The obtained data were interpreted through a medical lens and in the light of information derived from the palaeopathological literature (Galassi *et al.* 2020, Varotto *et al.* 2020).

RESULTS OF THE MULTIDISCIPLINARY ANALYSIS

Dating

The results listed in the graphics show that the textile sample (**LTL17426**) and the wooden specimen of the coffin (**LTL17850**) are statistically in agreement within the same chronological period, thus confirming the stylistic-archaeological dating of Usai's funerary set (7th century BC, *Figure 1a, b*).

State of preservation

Although no conservation index was applied due to the fact that mummy was still wrapped in its bandages (*Figure 2*) and all the assessment had to be mediated by radiological images, from an observational qualitative perspective the mummy presented in a good state of preservation of the individual's anatomical structures, with the exception of some *post-mortem* loss

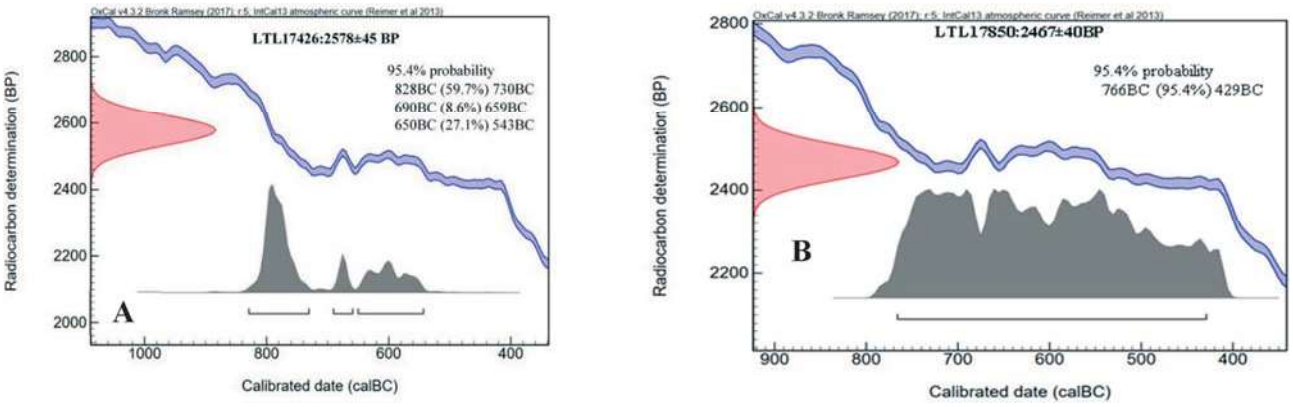


FIGURE 1: ^{14}C dating.

FIGURE 2: The wrapped mummy of Usai.

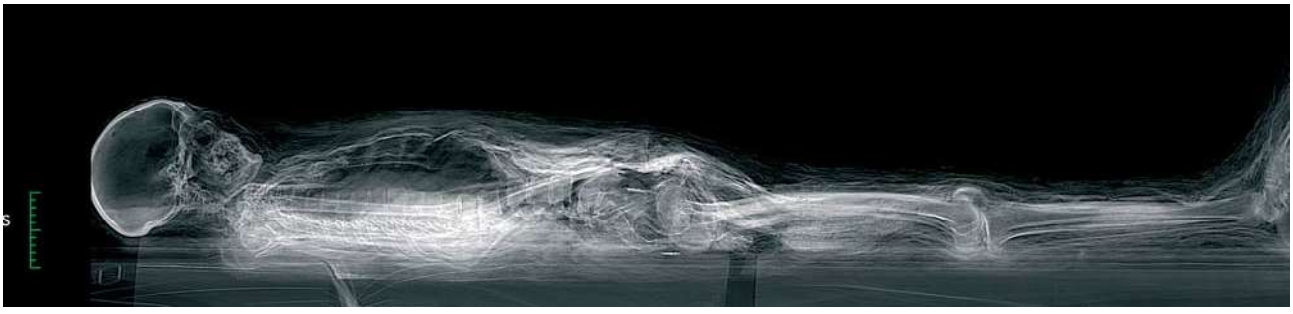


FIGURE 3: Total body CT scout view image of the mummy of Usai. *Post-mortem* dislocation of the L1–L3 segment of the spine and a supernumerary thoracic vertebra can be seen.

of anatomical connections, particularly in the spine at the L1–L3 vertebral level, as clearly shown in the lateral scout view of the CT scan (*Figure 3*).

Anthropological assessment

The individual lies in a supine position, heavily compressed in the more cranial regions of the corpse by his bandages, which ultimately caused the clavicles to be markedly verticalised, the right upper limb internally rotated and the head bent laterally, to the right. The individual's arms are slightly flexed on the abdomen with the hands positioned at the level of the hip and medially to the proximal portions of the femora.

The individual's age at death as estimated around 50 years based on the pubic symphysis (Buikstra, Ubelaker 1994) – excluding pathological alterations at the dental and arterial levels, which do not exclusively depend on age). The sex, supposed to be male based on the attribution of the mummy to the inscribed coffins, was confirmed so thanks to the preservation of the penile anatomical structure as well as through the assessment of pelvic morphology (Ferembach *et al.* 1980).

The individual's stature was determined to be 160.028 cm measuring from the highest cranial point (bregma) to the calcaneus on CT images, although, taking the aforementioned compression into account, a few more centimeters could be added. Stature was also estimated from the length of the long bones using the Sjøvold formulae (Sjøvold 1990), which yielded 165.3 cm ± 4.94 SD based on the length of the left humerus and 164.8 ± 4.52 SD based on the length of the right femur.

Moreover, it can be underlined that the individual presents a medium to high muscular development which, on CT scans, can be clearly seen at the level of the attachment of the deltoid muscles on the clavicles and the deltoid tuberosities of the humeri.

Observations on the practiced embalming

An incision can be seen in the left hemibody superiorly to the iliac crest, the likely entry to the visceral cavity used by the embalmers to eviscerate the corpse. It can be mostly excluded that his skull was subjected to major excerebration procedures, since the ethmoid bone was found intact (*Figures 4, 5*). Nonetheless, some manipulation of the walls of the orbits are likely to have occurred, from where some resinous material may well have been cast into the cranial cavity: this

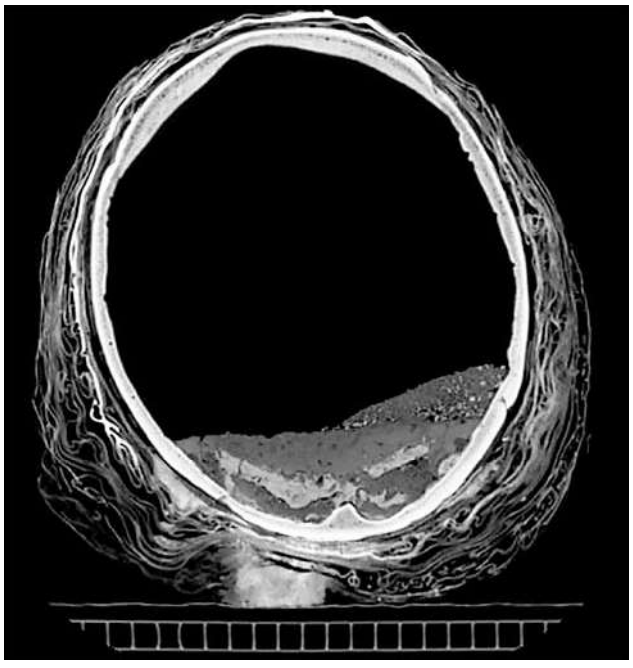


FIGURE 4: Transverse section of the skull: part of the brain mixed with resinous material is still visible in the occipital region.

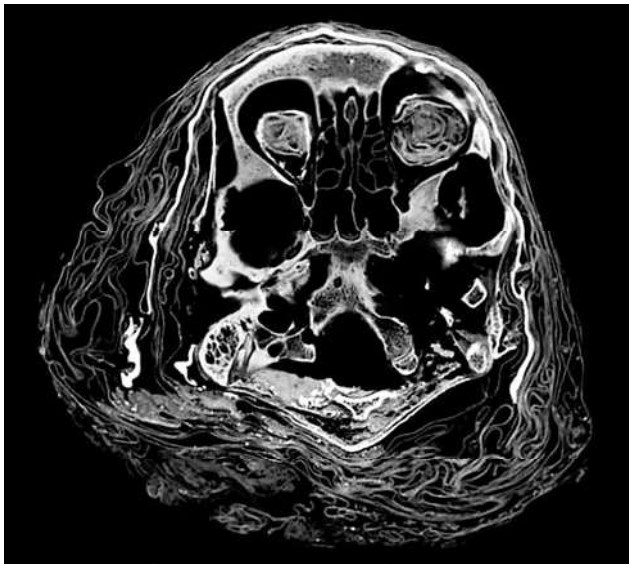


FIGURE 5: Transverse section of the skull: presence of textiles in substitution of the eyes. Substantial preservation of the ethmoidal anatomy.

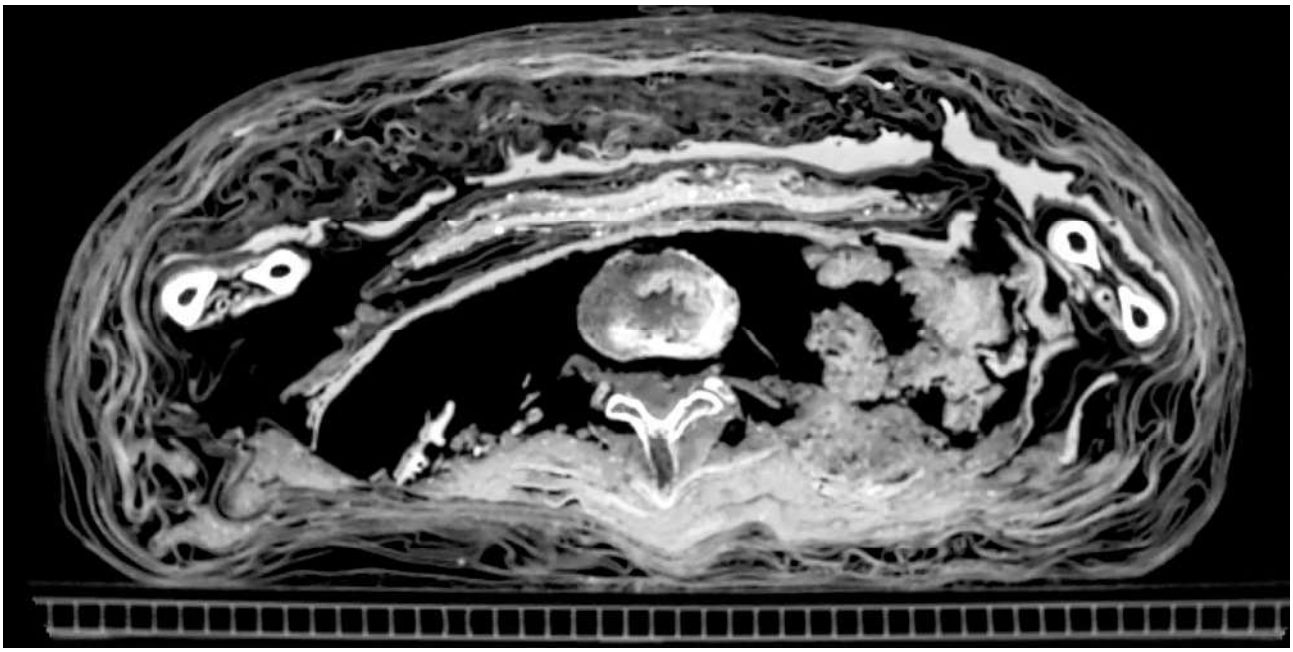


FIGURE 6: Transverse section of the abdomen (lumbar level): dehydration packets located between the abdominal bandages.

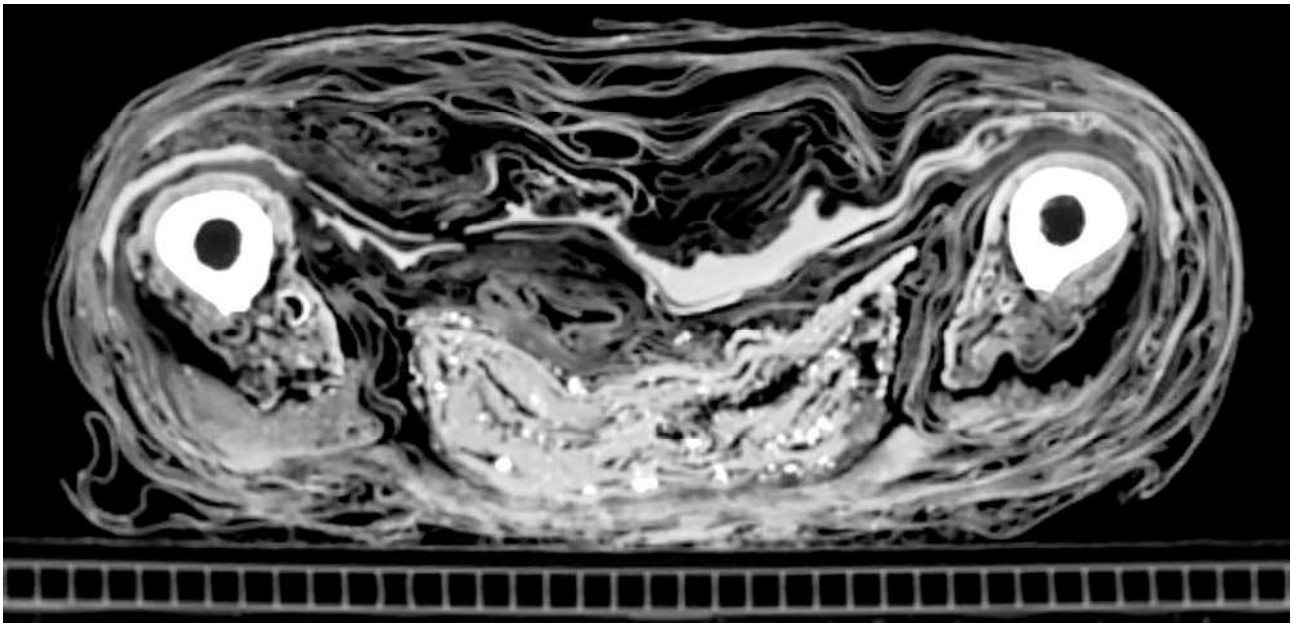
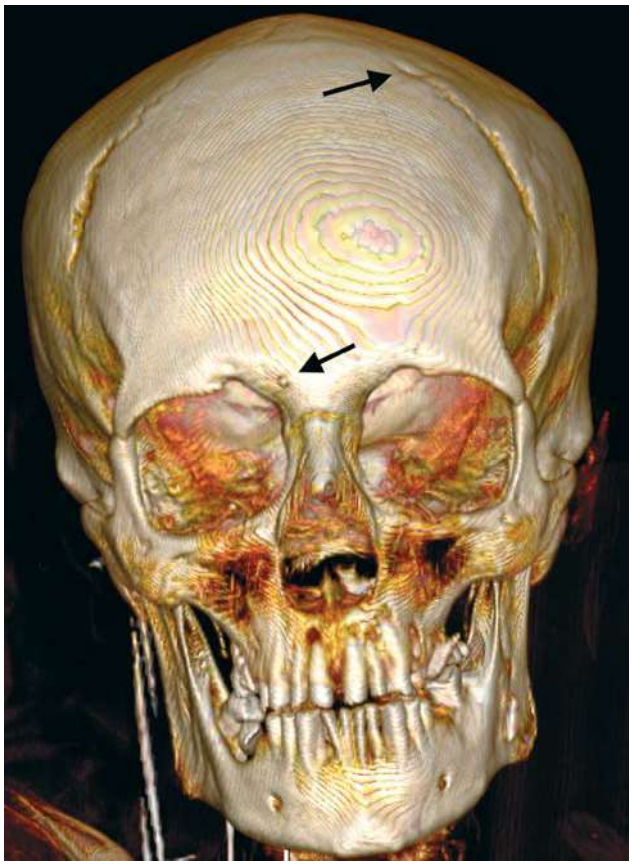


FIGURE 7: Lower limbs: presence of dehydration packets between the individual's femora.

possibility could be supported by the evidence of various densities in the intracranial remnants located in the occipital area, of which the lowest one is likely to be the real cerebral substance. Usai's eyeballs are absent and were substituted with textiles forming artificial globes (*Figure 5*).

In addition, visceral inclusions (packets) likely containing dehydration salt were identified in the



mummy's abdomen and between its legs (*Figures 6, 7*).

Pathologies

Several lesions were highlighted. In the skull, a well-healed depressed fracture (sagittal diameter = 2.12 cm, transverse diameter = 1.08 cm) close to the left side of the coronal suture, which, based on its morphology, it the likely outcome of an episode of interpersonal violence occurred *intra vitam* – although no certainty exists as to the exact cause of the lesion. Additionally, a frontal bone osteoma (size = 0.3 × 0.3 cm) (*Figure 8*) and dentoalveolar diseases (e.g. caries such as the evident *caries profundissima* on the left maxillary M2, periapical granulomas on the maxillary right and left I1, P1, left C, left P1, etc., while in the left hemimandible M3 is not erupted) were detected.

In the spine it is possible to identify advanced osteoarthritis of the cervical vertebrae, hernias and

FIGURE 8: 3D virtual reconstruction of the skull showing (arrows) a frontal bone osteoma and a well-healed blunt force trauma on the coronal suture in the left hemi-cranium.

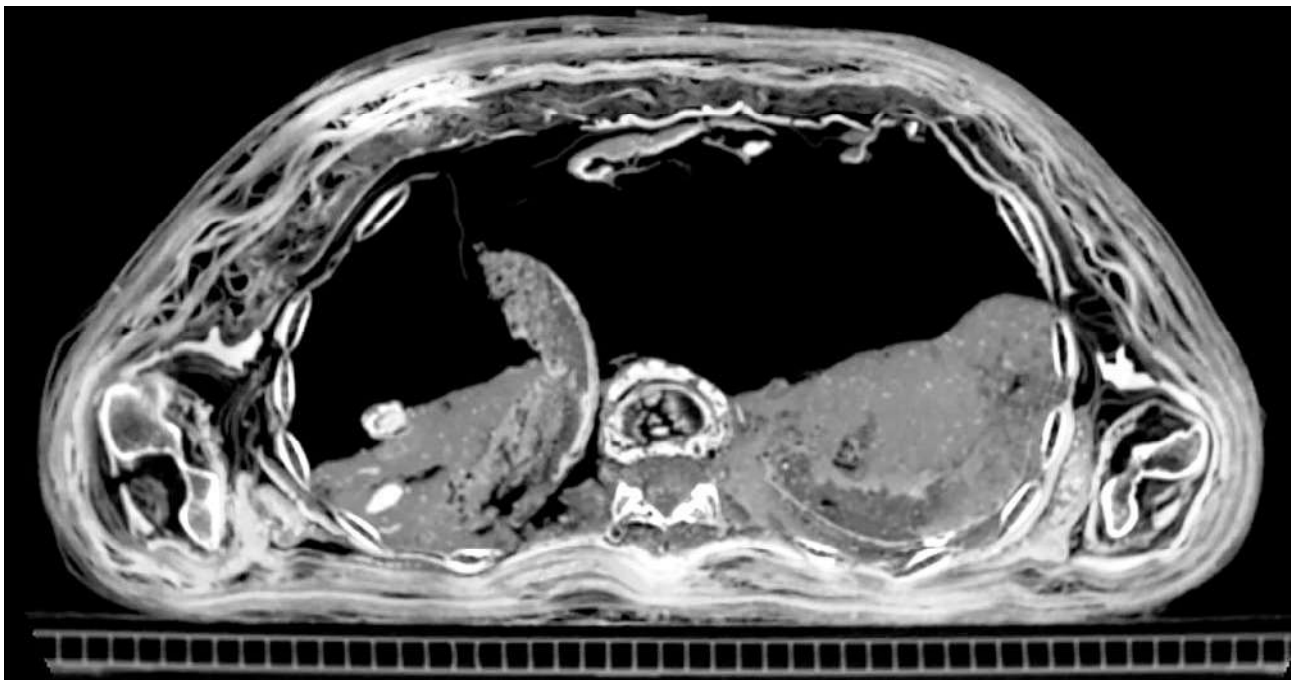


FIGURE 9: Transverse section of the thorax highlighting pulmonary remnants and a vertebral hernia as well as osteophytes.

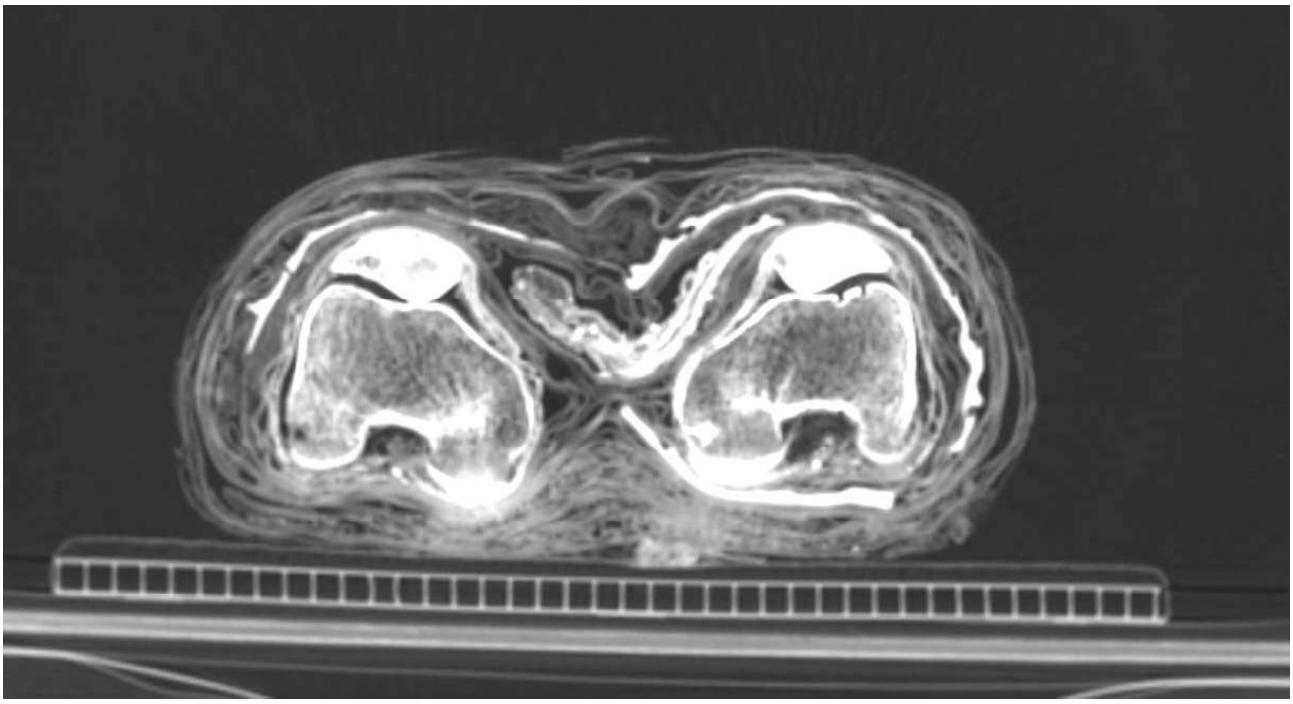


FIGURE 10: Osteoarthritis of the patellae and femoral condyles.

osteophytes in the bodies of the thoracic and lumbar vertebrae (*Figure 9*), which can be attributed to grade 2 of the Kim *et al.* classification based on dry bones (Kim *et al.* 2012), indicating vertebrae which exhibit 'more lipping on the margins, projecting almost horizontally from the vertebral body'. Moreover, the sacrum shows spina bifida occulta.

In the lower limbs advanced patellofemoral osteoarthritis could be spotted (*Figure 10*). Moreover, in the cardiocirculatory system, arterial calcifications were detected (internal femoral artery, superficial femoral artery, popliteal artery, anterior tibial artery).

Thirteen thoracic vertebrae were counted and the thorax show a *pectus excavatum* (funnel chest) conformation. It is reasonable to postulate that this morphology is the result of a combination of a congenital defect and the *post-mortem* depression of the thoracic cavity caused by the anthropogenic evisceration process.

Usai's *causa mortis* cannot be determined based on the collected evidence, since all the described lesions are not lethal per se. The absence of his internal organs *in situ*, with the exception of some pulmonary remnants (*Figure 9*) in which no pathological alterations can be identified, and the unavailability of the canopic jars linked to his burial do not allow us to formulate a definitive conclusion.

CONCLUSIONS

The mummy belonged to a male individual, with average age at death of 50 years, who suffered from a series of age-related conditions, none of which appears to have caused his death. The embalming technique follows in the footsteps of previous data on evisceration, but it highlights a rarer form of incomplete excerebration through the orbits.

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