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Case Report

Paleoimaging of a modern mummy from Lithuania (circa 19th–20th century)

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ABSTRACT

An anthropogenic human mummy curated in the Museum of the History of Medicine, Vilnius University, was recently examined by means of computed tomography. Although the mummy lacked data regarding its specific context and historical information on its identity and chronology, the investigation focused on the embalming method adopted to preserve it. Some pathological alterations were also recorded. This research appears to suggest that this body was prepared for educational and/or scientific purposes rather than funerary purposes. Hence, the case could be categorized as a ''medical mummy'' prepared between the mid-19th and the mid-20th centuries.

1. Introduction

Human mummies, either spontaneous or anthropogenic, represent a precious heritage, as they are an open window into health conditions, lifestyle and mortuary patterns of once-living populations [1]. These types of remains are common in both the historical and forensic setting and have been subjected to scientific studies for over two centuries [2,3]. In this respect, Lithuania is a country rich with preserved corpses, and in the past years academic efforts have obtained significant bioanthropological information by scientifically investigating these bodies [4,5]. While historic sources and artifacts associated with the remains are useful for reconstructing the context from which they came, sometimes this is not possible due to the lack of documents or other elements [6].

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One such case is this mummy curated in the Faculty of Medicine, Vilnius University. The body is part of the anatomical collections of the Department of Anatomy, Histology and Anthropology: however, no written source describing its origin or chronology has been found, and the information gathered from members of the faculty is anecdotal. Therefore, the only way to reveal details about this mummy in a non-destructive manner was to submit it to a paleoradiological investigation, relying upon a computed tomographic approach [7]. Computed tomography has in fact been reported as a technique for mummy investigation since 1979, and it is of relevance due to its non-invasiveness, the possibility of post-processing the data, and the creation of three-dimensional reconstructions [8]. Within the framework of the ''Lithuanian Mummy Project'', in 2015 the mummy was transported to the Vilnius Medea Clinic for CT scanning and soon afterwards, was placed in the Museum of the History of Medicine where it is still on exhibit today (Fig. 1). The present article aims at disclosing details on this subject, his mummification process, and any possible pathological condition observed.

2. Materials and methods

The body measures 167 cm in height. Based on the external visual inspection, the mummy belongs to that of an adult male with the arms extended along the sides of the body and the hands crossed over the pubic region, covering the symphysis and genitalia. The penis and the scrotum are visible. The mummy shows the presence of dark hair, beard and moustache. There is a 2-cm opening on the left anterior chest wall at the 3rd–4th intercostal space. Suture-closed incisions are located on the neck and thighs, and open incisions are present on the abdomen and scrotum, consistent with multi-site injections indicating that the corpse was anthropogenically preserved. On the anterior surface of the body, the skin has a shiny darkened appearance suggestive of tanned leather. Additionally, numerous small raised skin lesions are scattered over the entire skin surface. A metal support maintains the body in an upright position. The remains were examined using a Philips Brilliance 16-slice CT scanner (the Netherlands), and the protocol included a 0.8-mm slice in thickness, 120 kVp,

Fig. 1 – Image of the mummy of an adult male, curated in the Museum of the History of Medicine, Vilnius University. Note the small lesions scattered on the skin.

Fig. 2 – Preserved brain, temporal fossa, and cerebellum (arrows).

250 mAs. Furthermore, the Hounsfield Unit scale was employed to measure radiodensity. Image reformatting and interpretation were performed using Apple platform OsiriX DICOM viewing software (version 7.5.1 64-bit, developed by Antoine Rosset, MD, 2004, Geneva, Switzerland) on an Apple iMac Retina 5K, 27-inch, 4 GHz Intel Core i7 computer, OS X 10.11.5.

3. Results

Review of the CT images shows thin dura and falx within the cranium. A small amount of preserved brain is seen in the cerebral hemispheres, temporal fossa, and cerebellum (Fig. 2). The vitrea of both globes has dissolved. A small round high density (887 HU) deposit consistent with calcium is present on the posterior aspect of the left optic globe remnant. The location and appearance are consistent with an optic nerve head drusen. The optic nerves are intact. The sinuses are clear. In the neck, preserved walls of the great vessels are visible. At the chest level, preserved walls of the aortic arch, ascending and descending aorta, and cardiac chambers can be noted. The pleural and pericardial reflections and diaphragm are also preserved (Fig. 3). Stippled calcification of the costochondral cartilages and tracheal rings is also visible. It is also possible to note posteriorly dependent consolidated lung tissue, characterized by a high density of 2969 HU. The abdominal cavity reveals a posteriorly dependent high density liver of 2199 HU and a spleen of 2976 HU. The high density of the lungs, liver and spleen suggests the presence of embalming fluid containing heavy metals. The kidneys are posteriorly dependent, and three small round calcifications project over the left kidney, which measure 2 mm, 5 mm, and 6 mm, respectively (Fig. 4). Low density stool is seen in the rectal vault. Overall, the imaging of this body better reveals the incisions located in the right neck (6 cm), left neck (5 cm), midline abdomen-infraumbilicus to symphysis (12 cm), symphysis extending inferiorly into the left scrotal sac (9 cm), as well as right (10 cm) and left upper thigh (11 cm) consistent with multiple embalming injection sites including the carotid and femoral arteries as well as the abdominal aorta (Figs. 5 and 6). With regard to the skeletal system, the sexual dimorphic features of the pelvis support the male gender that was determined externally. The epiphyses are fused indicating an adult age. All bones are present and the skeleton is intact, with no evidence of premortem or post-mortem fractures. The upper and lower extremities, fingers and toes are intact (Fig. 7). There is narrowing and sclerosis of the left sacro-iliac joint suggestive of sacroiliitis. There is narrowing of the bilateral hip joints. Sclerosis on the acetabular surface of the bilateral hip joints is

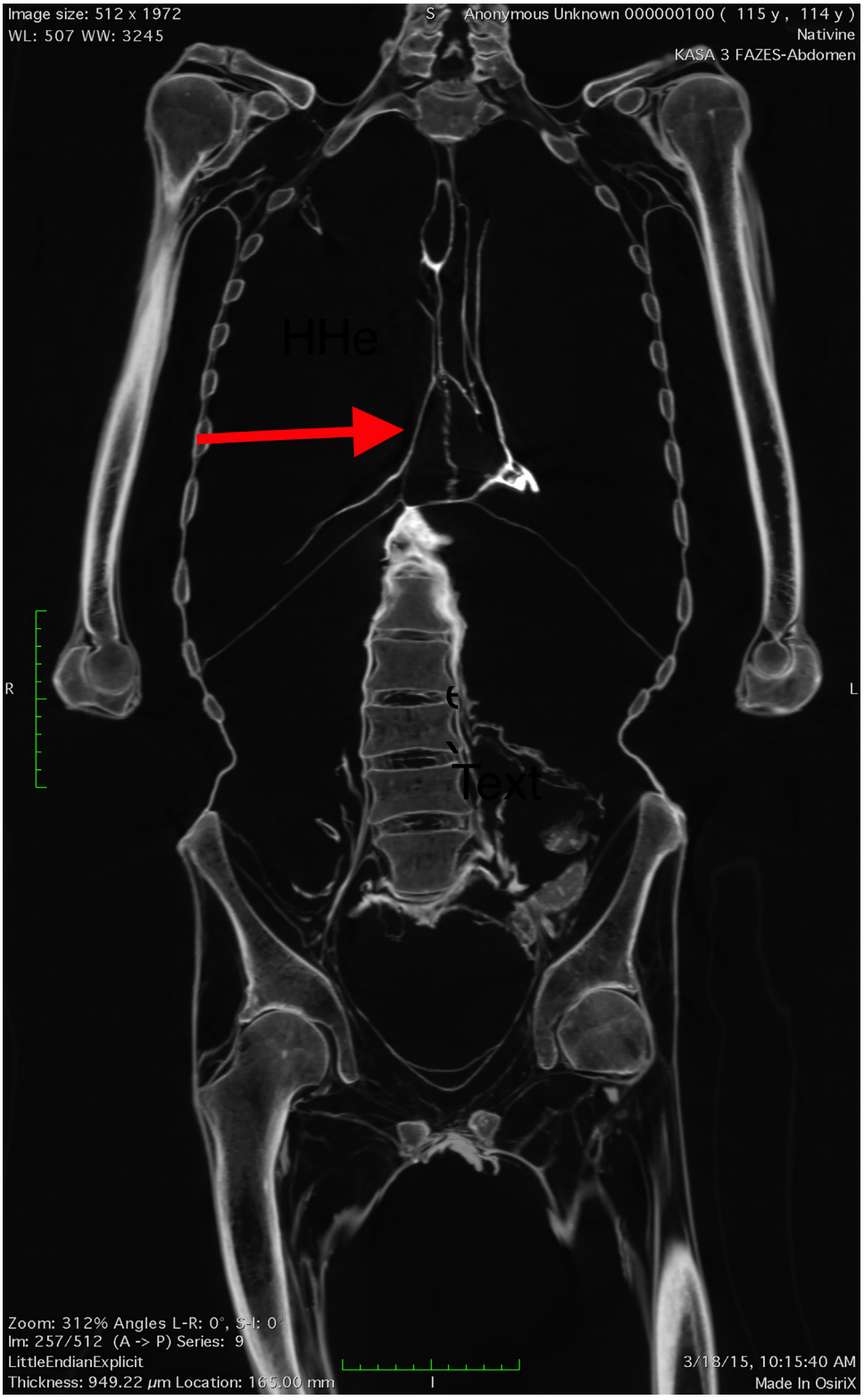

Fig. 3 – Preserved pleural/pericardial reflections and diaphragm (arrows).

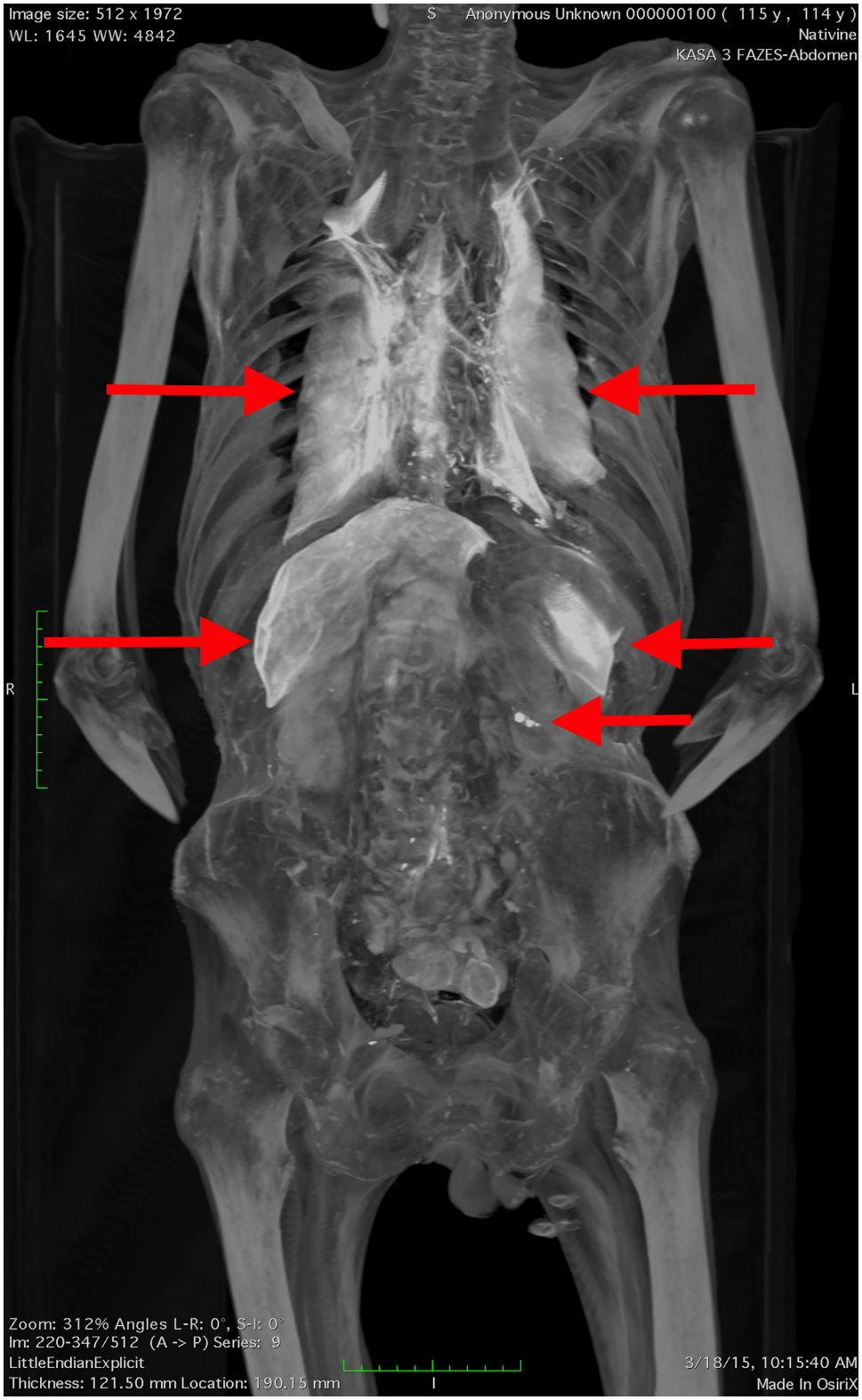

Fig. 4 – Dense lungs, liver, spleen; calcifications project over the left kidney (arrows).

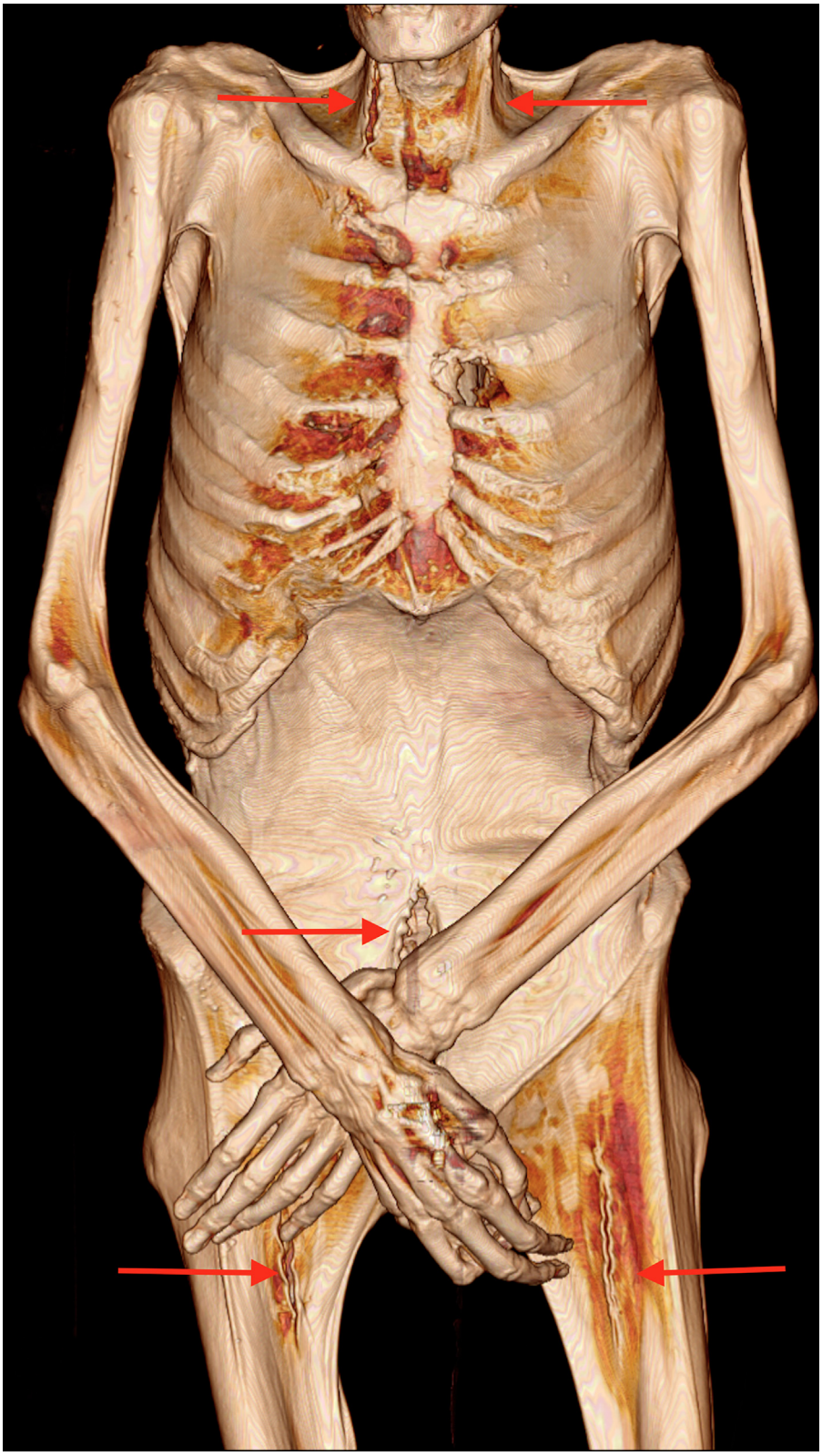

Fig. 5 – Embalming incisions; neck, midline abdomen, scrotum, upper thighs (arrows).

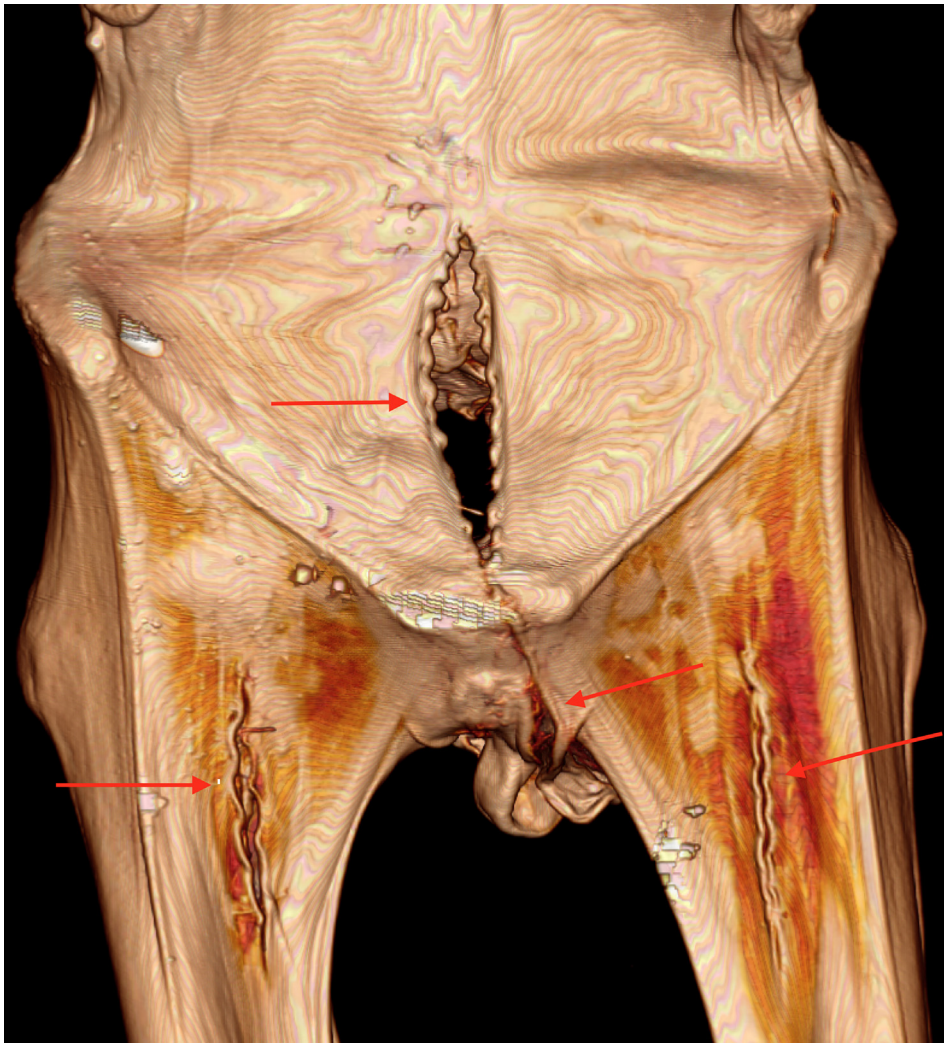

Fig. 6 – Embalming incisions; midline abdomen, scrotum, upper thighs (arrows).

consistent with mild degenerative joint disease. The spine is intact, with no evidence of degenerative joint disease or fracture, while dependent remnants of the spinal cord are noted in the spinal canal. The intervertebral discs appear desiccated. There are small Schmorl's nodes involving the inferior endplates of T6, T7, T8, T9, T10, and the superior endplates of T11 and T12 (Fig. 8). There is no scoliosis. Reconstructed images of the right maxillary teeth show a damaged central incisor, lateral incisor, and canine, missing first and second bicuspids, first, second and third molars, while those of the left maxillary teeth show a damaged lateral incisor and second molar with significantly worn occlusal surface. The central incisor, canine, first and second bicuspids, as well as first and third molars are missing. Reconstructed images of the right mandibular teeth show damaged central and lateral incisors. The second bicuspid, as well as the first and second molars have significantly worn occlusal surfaces. The canine, first bicuspid and third molar are missing. The left mandibular teeth show damaged lateral incisor and canine. There is also a periapical abscess at the root tip of the canine. The central incisor, first and second bicuspids, first, second and third molars are missing. Finally, there is significant remodeling of the maxillary and mandibular alveolar ridges consistent with intra-vital tooth loss.

4. Discussion

The main purpose of this research was to shed new light on this mummy, which lacks a proper historical and documentary context. In order to do so, we focused on the external features and the technique used to preserve the body. The presence of several incisions indicates that this is a case of chemical embalming mainly obtained via a multiple-point injection method [9]. The injection method may have been associated with immersion of the cadaver into a preservative solution [10]. By the end of the 17th century, preservation of bodies for anatomical purposes began to include methods of injection, based on the introduction of preservative fluids into the vascular system by means of syphons [11]. However, for over a century, the systems employed to prepare a body had combined the new chemical approach with the traditional surgical procedure, which included evisceration for at least part of the body cavities. In this sense, a physical example is

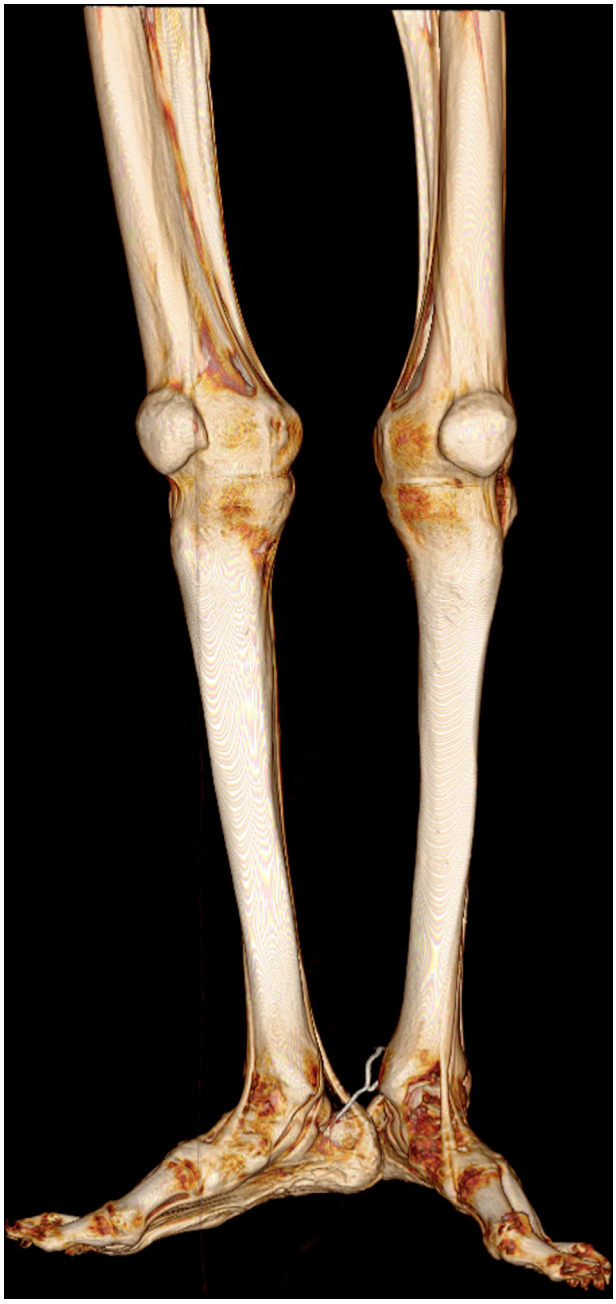

Fig. 7 – Lower extremities.

represented by three subadult mummies of members of the Agar family, buried in the Basilica of San Domenico Maggiore in Naples in the early 19th century [12]. It was only after 1835 that arterial injection was indicated as a sufficient approach to embalm and preserve corpses, without the need to eviscerate them or to submit them to other extreme manipulations. In that year, Sicilian physician Giuseppe Tranchina published a memoir on the corpses he had embalmed in Naples using a single-point injection of an alcohol or water solution of arsenic and cinnabar [13]. One of the earliest examples treated with Tranchina's method was the body of Gaetano Arrighi, an Italian man detained in the penal colony of Leghorn [14]. Around the same time, French chemist Jean-Nicolas Gannal also devised his own method of arterial injection, which did not include evisceration and contained alum, sodium and potash [15]. Given that the popularization of intra-arterial injection took place since the mid-19th century, it is reasonable to consider 1835 as a *terminus post quem* for the embalming of the body described in this paper. Observing this type of treatment of a body can either indicate a higher social status in life, expressed by the care taken in the post-mortem treatment, or the use of a cadaver for experimental and/or educational purposes.

Another relevant point to consider for the case under study is that regarding taphonomic changes. In general, bodies laid to rest in a supine position, either spontaneously or anthropogenically mummified, show a posterior flattening determined by placing them on a hard surface, such as the bottom of a wooden coffin [3]. In the individual under study, such a feature is lacking. Additionally, no imprints of textiles determined by clothing were observed, suggesting that the body may have been located in an upright position shortly after its preservation, which, as previously mentioned, was likely determined by a combination of injection and immersion. Taking these details into account, it may be possible that the body represents a so-called ''medical mummy'', a term that indicates entire cadavers or body parts prepared for medical education and teaching. Examples include the collection of Paolo Gorini in Lodi [16], that of Giuseppe Paravicini in Mombello [17], or even the famous Allen Burns collection in Baltimore [18], to name but a few.

As regard the paleopathological characteristics of the subject, there is a unilateral inflammatory process at the level of the left sacro-iliac joint. In addition, numerous Schmorl's nodes, protrusion of the nucleus pulposus into the vertebral disk, are present in the spine. Mild osteoarthritis, a deterioration of bone joints, may be age-related. Moreover, the dental status of the individual appears to have been very poor, as suggested by the presence of tooth loss, dental wear and even an abscess [19]. However, the nature of the tooth damage could not always be distinguished. Finally, the nature of the skin lesions appears to be related to taphonomy, rather than determined by a disease.

It remains quite difficult to establish exactly when the mummy was produced. Of note is the fact that no mention of this body was found in the inventory of the previous anatomical museum [20]. This collection was transferred to the new Anatomicum, which is part of the Faculty of Medicine; where, since 1924, a new pathological assemblage was created [21]. In that period, embalming was certainly performed in Lithuania, as confirmed by the treatment of the cadavers of the pilots Steponas Darius and Stasys Girėnas by anatomist Jurgis Žilinskas in 1933 [22]. The turn of the 19th century saw a progressive change in the use of embalming chemicals, shifting from heavy metals such as arsenic and mercury to formalin-based fluids [23]. The high density of the lungs, liver, and spleen suggests that heavy metals may have been employed in this mummification process [13]. The only method to solve the case would be a chemical analysis of a tissue sample, which would reveal what preservatives were used for the body preparation and if a surface treatment was also performed [24].

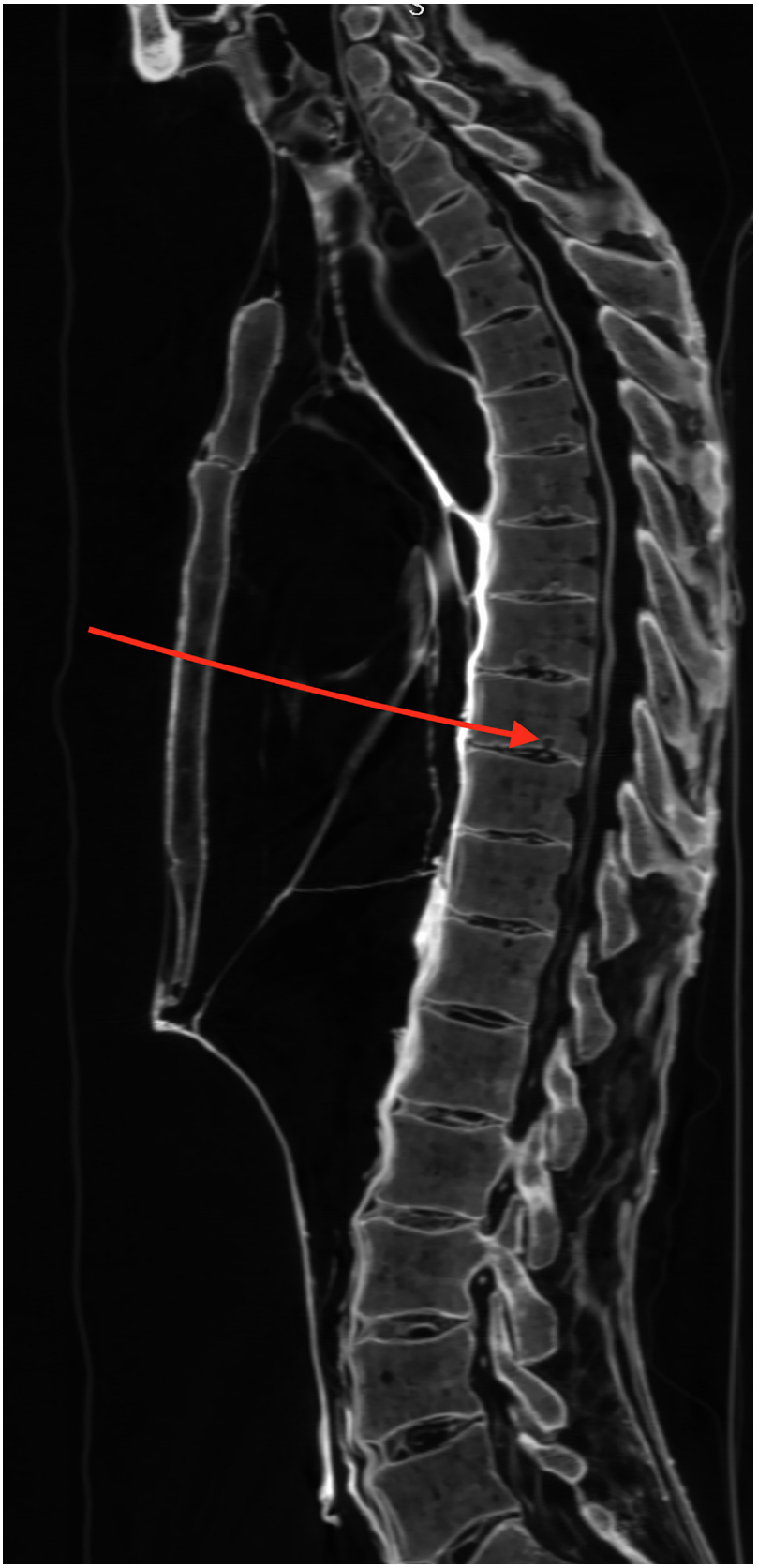

Fig. 8 – Example of Schmorl's nodes of the thoracic spine (arrow).

5. Conclusions

Based on its characteristics and on the data acquired via a computed tomographic investigation, the mummy located in the Faculty of Medicine of Vilnius University appears to be a body prepared for educational or experimental purposes, or a ''medical mummy'', rather than a subject embalmed for funerary purposes related to high social status during lifetime. This is particularly important for the museum in which the body is curated, as new knowledge was acquired about the item that can now be shared with the many visitors who view the collection. Additional historical and archival research, as well as a specific chemical investigation of the mummy, are imperative to shed further light on this subject and his mysterious identity.

Conflict of interest

The authors state no conflict of interest.

Acknowledgments

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