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Case review

Mummified remains from the Archaeological Museum in Zagreb, Croatia – Reviewing peculiarities and limitations of human and non-human radiological identification and analysis in mummified remains

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ABSTRACT

Forensic protocols and medico-legal techniques are increasingly being employed in investigations of museological material. The final findings of such investigations may reveal interesting facts on historical figures, customs and habits, as well as provide meaningful data for forensic use.

Herein we present a case review where forensic experts were requested to identify taxonomic affinities, stage of preservation and provide skeletal analysis of mummified non-human archaeological remains, and verify whether two mummified hands are human or not. The manuscript offers a short review on the process and particularities of radiological species identification, the impact of post-mortem changes in the analysis and imaging of mummified remains as well as the macroscopical interpretation of trauma, pathology and authenticity in mummified remains, which can all turn useful when dealing with forensic cases.

1. Introduction

Although the work of forensic specialists focuses mainly on human remains believed to be of medico-legal significance, it is not uncommon for them to get involved in the analysis of remains and artefacts that, at first glance, seem far beyond their range of interest and activity.

In many occasions forensic departments have conducted analysis on remains with no medico-legal significance, collaborating in multidisciplinary projects involving human archaeological, anatomical and museological specimens.[1–8] During these types of investigations, forensic specialists have the possibility to develop protocols for forensic authentication of artefacts,[1,3] as well as retrieve information (e.g. on taphonomy, trauma analysis) that could afterwards turn useful in daily medico-legal caseworks.[9] Beside human remains, material submitted to forensic evaluation may include also nonhuman remains. Attesting whether remains are human or not with no need for detailed species identification is the task most commonly performed by forensic anthropologists.[10] In these occasions, once the remains have been identified as nonhuman, the forensic interest of the finding can be ruled out.[11] However, with the development of forensic veterinary science and the increase in animal cruelty and wildlife crime investigations, nonhuman remains gained forensic significance, making the determination of species essential and the analysis of nonhuman remains much more elaborate.[12,13] Whether a superficial species evaluation or accurate species identification is sought, the techniques used are the same, and range from macroscopical,[14] histological,[15] radioimmunoassay[16] to molecular analysis,[13,17] and in some cases radiological examination.[18]

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Human and nonhuman identification and analysis of nonhuman animal remains may involve material in different stages of preservation, including mummification. Although mummy studies are being extensively published in international literature, there has been little discussion on forensic radiological species identification and analysis of mummified nonhuman remains.

Since forensic experts, in absence of other close specialists, can be asked to participate in investigations involving historical specimens and nonhuman remains, they should be adequately prepared to handle such cases.

We present a small case series of skeletal identification and investigation performed on Egyptian mummified remains curated in the Archaeological museum in Zagreb, Croatia and believed to be of animal origin, followed by a review on the taphonomy, imaging and forensic analysis of nonhuman mummified remains. The analysis of remains was requested because the remains have never been targetedly analysed and the impact of time and subsequent improper handling of remains affected their appearance, preventing a proper recognition of the remains enclosed. Since the museum records have never been objectively checked, the main goal of the study was to determine if the wrappings contain any skeletal parts at all, and if so, to determine their taxonomic affiliation, integrity, authenticity and presence/interpretation of visible trauma/pathologies.

Although conducted on an archaeological sample, the information on imaging, identification and interpretation of skeletal findings in material subjected to mummification, can turn useful to forensic professionals dealing with similar cases: (i) cases involving mummified remains of doubtful origin (human-nonhuman identification of mummified remains), (ii) cases involving ancient mummified artefacts submitted to forensic departments for their interpretation and authentication, (iii) cases involving mummified animal remains or bodily parts for forensic evaluation (species identification, trauma analysis) in cases of suspected animal abuse, smuggling etc., (iv) analysis of mummified small human bones that present with similar problems and limitations as imaging of small nonhuman remains.

2. Materials and methods

Since the analysis of external features of the mummies has not provided enough detail to allow species identification and/or the stage of preservation of the remains, X-ray and MSCT imaging were performed. A total of five remains were radiologically examined at the University Department of Diagnostic and Interventional Radiology, Dubrava University Hospital in Zagreb, Croatia.

The remains analysed included an amorphous bundle of tissue with almost no bands and with protruding skeletal parts measuring 196 × 124 × 44 mm (no further information was available) (Fig. 1a), a bundle measuring 450 × 85 × 85 mm, which with its spindly shape and the narrow posterior and broader anterior part bore resemblance to a juvenile crocodile (recorded as a crocodile mummy) (Fig. 1b), a bundle measuring 475 × 175 × 100 mm and resembling a mummified ibis (recorded as an ibis mummy) (Fig. 1c) and an amorphous mummy measuring 190 × 70 mm, morphologically similar to the first mummy (recorded as an unknown animal) (Fig. 1e). Besides that, the analysis included also a bare mummified hand (80 × 30 mm) whose human-nonhuman primate origin was questioned (Fig. 1d).

Digital radiographs in two directions (AP and LL) have been obtained (RadSpeed Saphire, Shimadzu Europa GmbH, Duisburg, Germany). A 16 × 0.75 collimation and 0.7 mm-reconstruction increment was used to obtain isometric slices by means of a MDCT unit (Sensation 16; Siemens AG Medical Solutions, Erlangen, Germany). Scanning parameters were: 300 mA, 120 kV “Sharp” (70) and “soft” (30) kernels were used in postprocessing. Three dimensional (3D) reconstructions included maximum intensity projection (MIP) reconstruction, multiplanar reformatting (MPR) and volume rendering technique (VRT). 3D reconstructions were

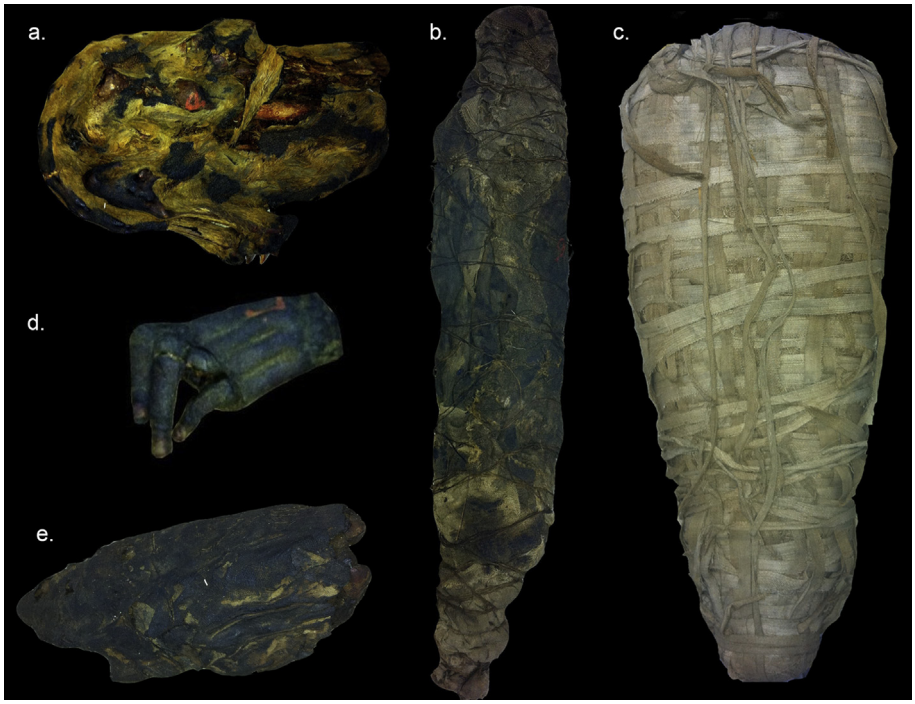

Fig. 1. External presentation of the mummies believed to have belonged to nonhuman species: a. cat mummy b. “crocodile” mummy c. “ibis” mummy d. “primate” mummified hand e. unknown mummy (another mummified hand).