Computed tomography alone reveals the secrets of ancient mummies in medical archaeology

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Diagnostics of ancient mummies has ever since provoked an unbroken fascination to man. Without opening the coffin and destroying the mummies, radiological diagnostics has become the forerunner, including conventional radiography and 3D computed tomography (CT). Nuclear medicine, using scintigraphy, single-photon emission tomography or positron emission tomography (PET), requires radioactive substances to be incorporated via the vascular system and distributed *in vivo* to the target cells, and, therefore, cannot be used in mummies. Computed tomography is now included in the form of fusion with PET images in nuclear medicine diagnostics. Thus, nuclear medicine indirectly relates to medical archaeology. Furthermore, new methods of biomedical engineering may be of interest in the future, such as optical methods, e.g., optical coherence tomography allowing for histologic noninvasive diagnostics of the skin [1].

Recently, other researchers published their so-called Horus study [2], named after the early Egyptian God Horus. Using whole body CT the aim of that study was to detect calcifications for supporting the presence of atherosclerosis in a young population of 137 mummies across four ancient populations. The results are intriguing showing that our modern disease atherosclerosis was already common in four prehistoric populations including preagricultural hunter-gatherers. However, it would be interesting to know if the obtained CT scan data of such a large population could tell us even more about their diseases, causes of deaths, bone and dental status, or mumification techniques. Besides, modern imaging reconstruction algorithms may help to reveal how these ancient people looked like (Fig. 1) [3]. This study may reveal much from an unknown ancient world.

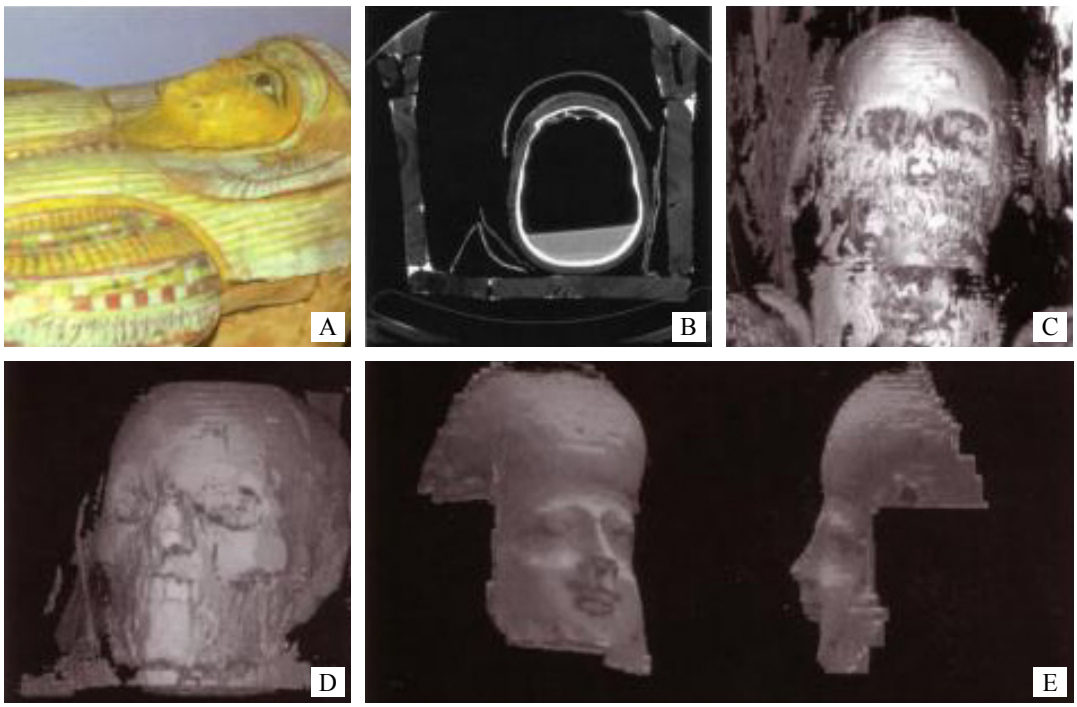

Figure 1. Egyptian mummy of the 18th-19th dynasty (approx. 1300 BC) from Thebes (currently Archäologisches Landesmuseum Konstanz), from reference [3], with kind permission from Prof. Dr. Dr. Andreas Beck. Panel A: Photography of the closed coffin; panel B: Spiral CT of the whole sarcophagus with honey-like liquid level in the debrained skull; panels C and D: 3D-reconstruction of the skull, panel C, windings, panel D, subcutaneous fatty tissue; panel E: 3D reconstruction of the face.

In an effort to realize how the people in mummies looked alike, we obtained a 3D-CT of an Egyptian mummy of the 18th-19th dynasty (approximately 1300 BC) from Thebes without opening the coffin. This mummy was from the Archäologisches Landesmuseum Konstanz [3] (Fig. 1). The 3D reconstruction of the face was calculated from the data set of the air between the dorsal death mask and the remaining, nearly destroyed face, the reconstruction algorithm was a 2mm reconstruction with maximum intensity projection (MIP) of the air behind the mask. After virtual removing of the thick windings in the face and of the mask itself, the remaining air was inverted yielding the real face of a young female priest. The main pathological diagnosis of this mummy was rheumatoid athritis with many affected joints including the elbow [3].

In conclusion, appropriate 3D-CT algorithms can help to reconstruct the face of ancient mummies, using the death masks included in the coffin.

The authors declare that they have no conflicts of interest.

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