

The Three Sisters: Multidetector Computed Tomography and 3D reconstructions of three sister mummies from the Egyptian Museum of Turin

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Abstract

The "three sisters" is a particular group of mummies from the Drovetti collection of the Egyptian Museum in Turin. They were purchased in 1824 by King Carlo Felice of Savoy for the new Museum. The mummies come from the area of Tebe in Upper Egypt. Their names are Tapeni (CGT 13002-Cat. 2215), Tamiu (CGT 13003-Cat. 2218), and Renpetnefert (CGT 13007-Cat. 2231). They were evaluated the same day with multidetector CT (GE Light Speed Qx/i). In all three cases whole body CT helical acquisition with thin slices (2.5 mm thickness, 1.25 mm reconstruction interval) followed by multiplanar and 3D reconstructions were performed. Stature, anthropometric measurements, sex, and approximate age, were estimated. Also embalming techniques, condition of the skeleton and of the soft tissues, and the presence of foreign objects were analyzed. The similarities and differences of embalming methods were also evaluated. To our knowledge, there are no other reports of CT studies on mummies belonging to the same family. We believe these results are of particular interest for archaeology and computed imaging technology.

Introduction

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The mummies come from the area of Tebe in Upper Egypt. Their names are Tapeni (cgt. 13002- Cat. 2215), Tamiu (cgt. 13003- Cat. 2218) and Renpetnefert (cgt. 1307- Cat 2231). According to the data found in the site of excavation they lived during the XXV Dynasty (VII-VI B.C.) and are referred as daughters of Ankhkhenu and Neskhensu.

Material and methods

For each mummy, a single whole body helical CT acquisition with a multidetector CT unit was performed, planning the acquisition on a digital radiogram (scout view). A multidetector CT unit Qx/i General Electric Medical

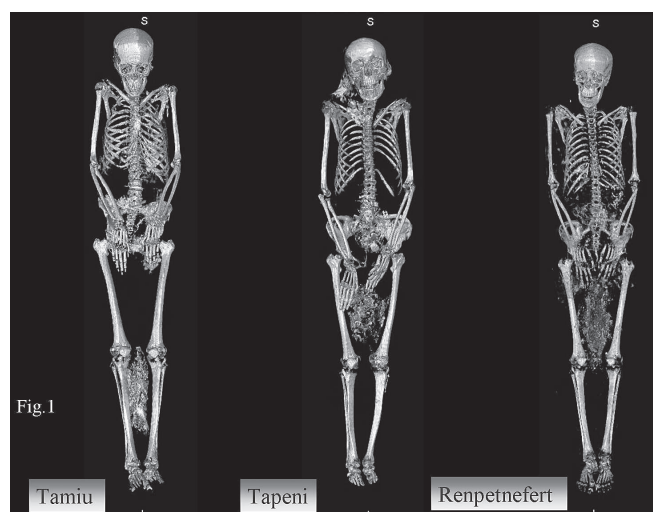


Fig. 1 - Virtual unwrapping of the mummies of the Three Sisters. After the progressive, virtual, removal of bandages and residual soft tissues the 3D reconstruction shows the position and the general condition of the skeleton.

System (Milwaukee, U.S.A) was used, with the following scan parameters: 120 KV, 200 mA, scan time 0.8, slice thickness 2.5 mm, reconstruction interval 1.25, High Speed modality, bone and standard algorithms.

Post processing with the evaluation of all the axial images, multiplanar and 3D reconstructions, including the virtual, progressive removal of the bandages (virtual unwrapping) (Fig.1), were then performed on two workstations: Precision 530 with 2.5 Vitrea software (Vital Images, Fairfield, IA) and Sun Workstation (Advantage Windows 4.2 GE Medical system).

In all the three cases a “CT report” was drawn up, considering the position and the state of conservation of the body, details of its different parts, thickness of the wrappings, presence and characteristics of foreign objects, anthropometric analysis and stature.

Results

Bandages had been removed in the past from Tamiu’s face, while the remaining part of her body and the other two mummies are still covered by thick layers of well preserved wrappings.

The three mummies are in supine position, the arms extended along the body, the hands laid flat over the pubis. The preservation condition of the skeleton is excellent and there are no signs of arthrosis.

Tapeni suffered from slight spine scoliosis.

There is no evidence of dehydrated brain tissue; only debris, more likely embalming materials, can be seen in the lowest part of the skull.

Bulb like structures are visible in the ocular cavities with no evidence of the optical nerve nor muscles.

Tamiu’s mouth is closed, while Tapeni and Renpetnefert have their mouth slightly open (Fig. 2).

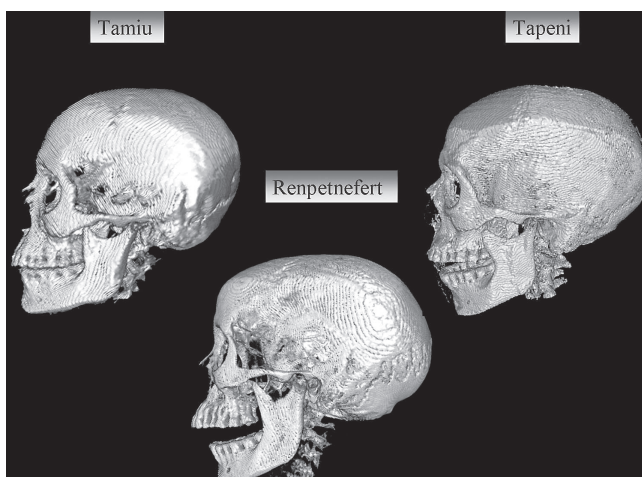


Fig. 2 - Lateral view of the three dimensional reconstruction of the skull of Tamiu, Tapeni and Renpetnefert showing the skull and the position of the mouth.

Dentition is good with no sign of attrition.

Tamiu’s chest is partially occupied by resins, but mediastinal structures are well evident. Tapeni’s sternum is displaced inside the chest cavity that looks mainly filled by resins. The

chest of Renpetnefert is completely filled by embalming material (Fig. 3).

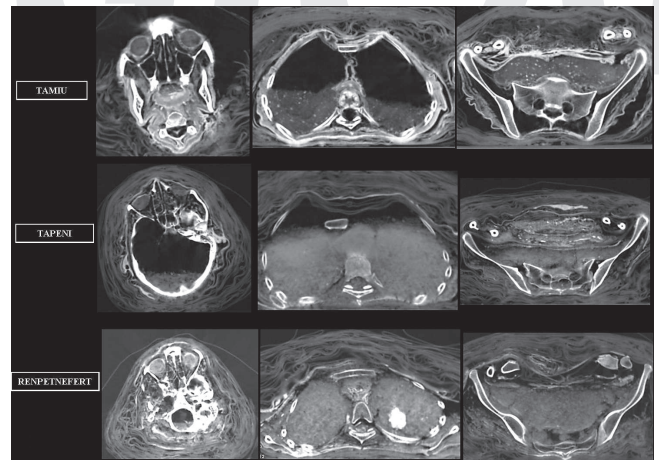


Fig. 3 - Comparison of axial scans of the skull, chest and abdomen of the Three Sisters, showing the thickness of the bandages, absence of cerebral tissue, debris in the skull and different amount of embalming material filling the chest and abdomen.

In none of the three mummies there is evidence of inner organs in the abdominal cavity, that is filled with several types of embalming materials. In Tapeni also the spinal cavity is partially occupied by hyperdense resins.

In Renpetnefert and Tamiu the access for the removal of the inner organs is visible on the left flank as a solution of continuity of the abdominal wall.

Stature, evaluated according to Trotter and Glaser formula (Trotter and Glaser, 1958) was estimated in 1.52 m for Tamiu, 1.54 m for Renpetnefert, 1.53 m for Tapeni (Fig.4).

Among the bandages of Tapeni and Renpetnefert small hyperdense foreign objects, probably amulets, were found.

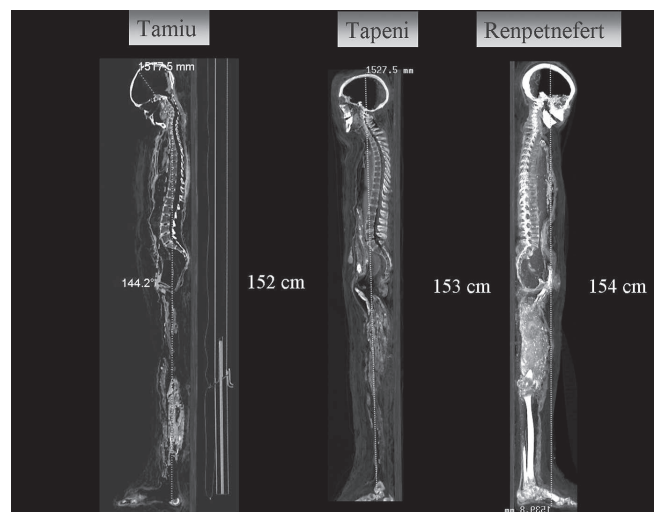


Fig. 4 - Sagittal reconstruction of the Three Sisters mummies with measurement of the length of the embalmed bodies. On the right the corresponding measurement of living stature according to Trotter and Glaser formula.

Conclusion

In conclusion, the study suggests that the three sisters have similar anthropometric characteristics and stature, in the

average of their contemporary people. According to the skeletal condition they all died young. The similar embalming technique was performed. Although radiological investigation showed that these three mummies are similar, further genetic studies should be performed in order to assess their actual relationship. In agreement with the results of other studies on mummies published by the same authors (Cesarani et al., 2003a,b) and other papers of the literature (Marx and D'Auria, 1988, Melcher et al. 1997, Bou et al., 1998) CT, especially supported by new post-processing techniques and the multidisciplinary cooperation among anthropologists, paleopathologists and radiologists, is fundamental in the non-invasive study of mummies.

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