

Original article

USING C.T SCAN AS NON DESTRUCTIVE TOOL FOR MUMMIES
EXAMINATION APPLIED ON TAYUHERET MUMMY (1054-1046 B.C.)

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Abstract

Using the advanced modern technology is considered to be one of the most important methods of scientific examination and registration. This should be used in the field of the conservation of the mummies. Identifying the case of the mummy and putting the mummy outwardly or inwardly is the first stage in the good prognosis of damage, which naturally leads to the development of an appropriate plan for the operations of treatment and conservation starting from the stage of cleaning till museum presentation consistent with the requirements of preventive conservation. Computed Tomography Scanning (CT scanning) since it is non-invasive and does not harm the mummies, has become an important tool for studying many features of ancient Egyptian mummies. Study of ancient Egypt, and particularly the examination of mummies, excites many people from all aspects of life. We have been fortunate to be able to apply modern diagnostic methods to the study of ancient human beings. "Tayuheret" mummy the Subject of paper, dates back to the Third Intermediate Period, 21st dynasty which was discovered in Deir al-Bahari in Luxor in southern Egypt in 1881, now housed in the Egyptian Museum. The study was divided into a full examination of the body from the head, Thorax, abdomen, pelvis and even district legs, CT studies confirm the ancient Egyptian used several methods for the degree of quality of mummification starting from the selection of Suitable materials filler internal to the body, CT studies confirm ancient Egyptian used methods to support the body and maintain the external shape of the mummy's body, research stressed the need for a new reading of the science of mummification according to the latest scientific methods of examination without any destructive effect on the components of the mummies.

Keywords: *Mummy, Fillers, Ancient Egypt, CT Scanning, Skull, Thorax, Abdomen*

1. Introduction

The ancient Egyptians left no accounts of their mummification techniques. It was the classical writers, particularly Herodotus and Diodorus, writing from an outsider's point of view and at a fairly late date, who provided the earliest descriptions of the process. Three methods of mummification were described, virtually all subsequent knowledge has been gained by examination of the

mummies themselves [1]. A collection of clippings are scattered carried many of the interpretations, and exegesis and so, the only way for the researchers and scholars is to detect themselves the methods used by the ancient Egyptians to mummify their dead and then as a result of the weakness of the possibilities and scientific instruments were resorting to open coffins in non-scientific ways and even remove the

wrapping of the mummies in ways that are inaccurate, which came in a lot of cases to damage cartonnage, coffins, wrapping of mummies and but brought some researchers attempts to dissection the mummies [2]. Despite all of these destructive methods for mummies, but they were not so lucky in the detection of mummification and what they have left us a lot of fallacies that need to be re-examined of the mummification in ancient Egypt.

With the stunning scientific development in the field of scanning and particularly the use of a CT scan to examine mummies without damaging the mummy, wrappings, cartonnage or coffins [3]. CT scanning examination gives a clear and complete idea that does not accept uncertainty about the methods of the ancient Egyptians to mummify their dead, this technique which tries to read the mummy of “Tayuheret-21st dynasty, third intermediate period”, fig. (1).



Figure (1) mummy of “Tayuheret” (C. 1054-1046 B. C.) the wife of high priest "Masaharta"

2. Historical background

Tayuheret (c. 1054-1046 B.C.).
Provenance: DB 320. **Discovery Date:** 1860? (Official discovery 1881). **Current Location:** Cairo Museum CG61091.
Biographical data: "Tayuheret" was probably the wife of high priest "Masaharta". **Details:** Tayuheret was found in a double coffin set which had been usurped from a chantress of Amen named Hatet (CG 61032). The gilded hands and faces of both coffins were missing, and the inner coffin had been further damaged. The mummy of “Tayuheret” was unwrapped by Maspero, G., on June 29th 1886. The resin coated linen carapace which covered her was allowed to remain in place. On July 6th, 1909, Smith, G. examined the mummy, and discovered that the resin used to fashion this carapace had been mixed with sawdust, an ingredient Smith had not previously seen employed in this fashion. He removed enough of this hardened linen to expose the face, but had to leave most of

it in place to avoid damaging the mummy [4]. Smith noted that Tayuheret's cheeks had been packed in order to flesh them out. He does not specify the packing material used in this case, but he describes it as being similar to that employed in the mummies of “Maatkare” and “Duathathor-Henttawy”. A Tayuheret's nostrils had been covered with discs of wax, and a type of nose-guard had been fashioned of wax for the purpose of preventing the nose from becoming flattened and distorted by the bandages [1]. She had been given a set of artificial stone eyes, and her right eye had also been covered by a wax plate. Wax was additionally employed to fill the space between the lips as described by Smith. Tayuheret's ears were covered with hair which Smith thought was mostly from a wig. Tayuheret's own hair was mostly white, indicating that she had died an elderly woman. Smith also noted that insects had damaged the skin of the face, especially

that of the forehead. This may indicate that an unusually long period of time had elapsed between Tayuheret's death and her embalming. However, her bandages also appear to be pitted with small holes which could have been caused by insects sometime after her embalming. Further-

more, Smith noted that the plate used to cover the embalming incision differs from the engraved plates usually employed during the 21st dynasty [5]. It was plain and fusiform, similar to the plates used by embalmers of the 18th dynasty.

3. Materials and methods

The wrappings of the mummy were completely intact. The author suspected at the outset that we might be dealing with layers of textile material of substantial thickness and resin or other botanic adhesives. To evaluate the mummy of

“Tayuheret” performed whole-body, 6-slice CT using a Siemens Emotion 6 (Florsheim, Germany), located in the Egyptian Museum in Cairo, fig. (2-a, b). according to Hughes, 1996 [6], the following operating conditions are used, tab. (1)

Table (1) System operating conditions

PHYSICIAN	Scan	KV	Mas\ref	CTDIvol	DLP	TI	cSL
Pation Position H-sp		130					
Topogram	1	130				11.0	0.5
Head	2	130	130	17.63	416	0.8	0.5
Control scan	3	130	45	9.85	1	0.8	1.0
Dental	4	130	45	12.36	148	0.8	1.0
Operation Body scan	5	130	58\124	7.70	506	1.5	1.0
Add scan	6	130	79\124	10.8mAS	2463	1.5	0.5

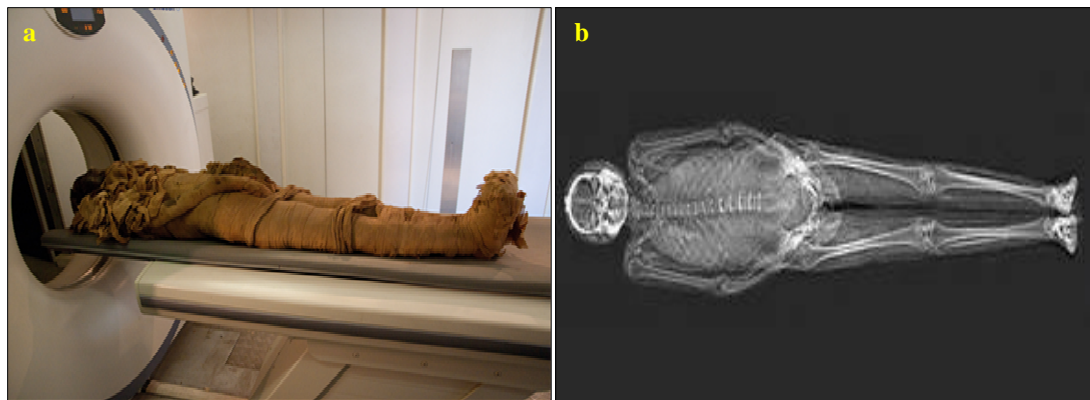


Figure (2) **a.** mobile Six-slice Computed Tomography Scanner, **b.** CT plate of the mummy.

4. Result

Through reading the resulted data of “Tayuheret” mummy by CT scanning, the following points could be noted: **a)** The process of extracting the brain was not made mainly in the mummification process, especially in 21st dynasty dating back to the mummy of “Tayuheret“. Also, and the embalmer could leave the brain or its remains, that needed to add resins in order to keep the brain from damage. **b)** There specific rules were not fixed to hold the mummification process, but the process is subject mainly to the skill of the embalmer and the state of the

body itself and the availability of raw materials used through the processes of mummification. **c)** Wrong storage leads to bad results, efflorescence of salt residues which were used in the mummification process, or blooms of salts that are found in materials which have already been used in the mummification process. **d)** The Embalmer’s ability to change the style of mumm-ification, according to the mummification process, and that even in a situation in which to hold the mummified of the body of the Corpse.

5. Discussion

5.1. The skull and the head

The studying of the head of mummy “Tayuhret” using a CT scan revealed that mouth is closed, all teeth apparently present. Artificial eyes inserted into the orbits. Non obvious fractures, cervical spine appears intact. Under the chin, in front of the neck, the ancient Egyptian did not remove the brain from the skull, but they leave the brain remains, in addition to some remains of resins in order to keep the brain [7]. It has been proven through the visual inspection of salt crystals on the mummy face, as well as CT scanning proved to be salt crystals at the bottom of the face between the skin of the face and skull bones, fig. (3- a, b). It is possible that the source of these salts

from the remnants of the Natron salt used in dehydration processes. As well as the possible result of excessive use of fillers, which led to the appearance of these salts as one of the components of the filling material and with exposure to the mummy of “Tayuhret” storage environment is not suitable salts led to the appearance on the face of the mummy. Ancient Egyptian tried to add artificial eye replacement of The left eye of mummy (the eyes were made of alabaster or oxidant) [8] as one of the materials vaccination, beeswax was used in the eyes and did not cover the use of vaccination in the right eye, as is evident by CT scanning.

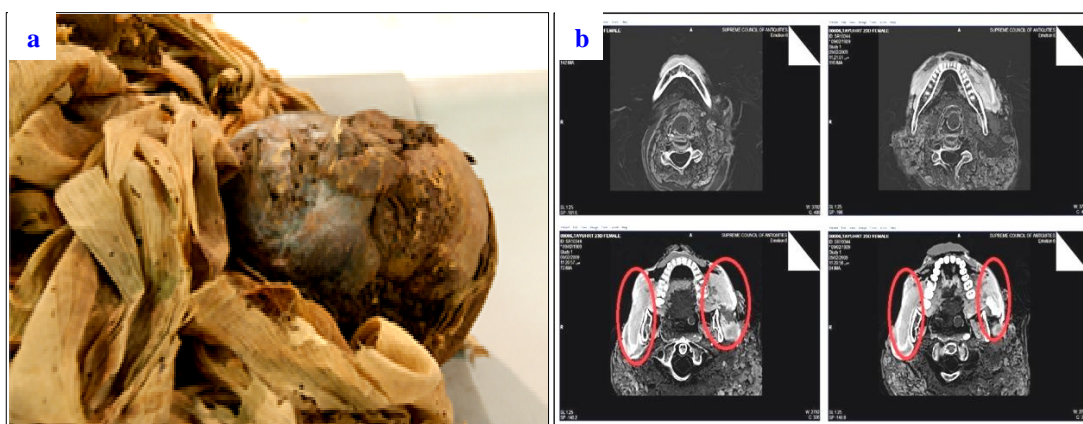


Figure (3) **a.** the face of Mummy “Tayuhret”, **b.** efflorescenc salts of filling material under the facial skin to surface.

5.2. Thorax and abdomen.

CT scan examination of the mummy of “Tayuhret” proved that it is filled with bundles of linen and packing material. Also, the usual four parcels of viscera was suffering from a large size. Therefore when the embalmer mummification process by adding fillers, which was the objective to maintain the shape of the body as it was before mummification processes. The embalmer supported the body of mummy by wooden rot down the back bone straight until can maintain the shape of the mummy without any damage. It is so clear that the embalmer used two types of

filling material, one of them was a heavy weight that increased of the size and weight of mummy body, so the embalmer used another lighter type so the form and consistency of the body could be kept, fig. (4). The process was succeeded, but the badly storage in a humid atmosphere led to blooms of salt filling material, especially in the face to the outside of the skin. It seems during the examination also, the embalmer added salt of Natron with filling material in order to maintain the degree of drying and to dry the body filling material used.

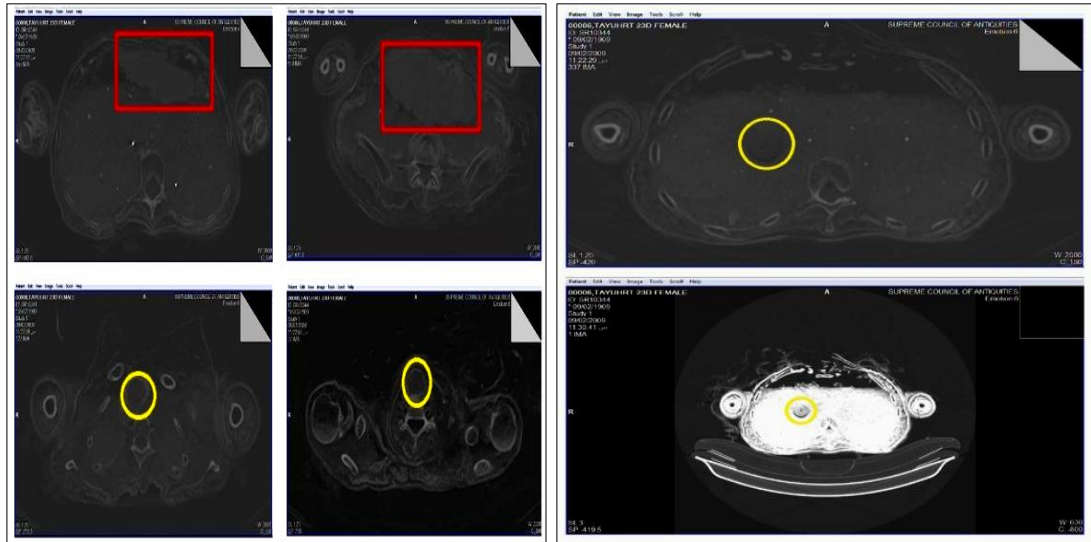


Figure (4) yellow circles represent the wooden rot support for the body down the back bone of mummy body. Red rectangle separates two types of filling material used by embalmed in mummy body.

5.3. Arms, pelvic and legs

The mummy arms have extended hands and its fingers were also extended over the pubic area. Within the same context, the examination using a CT scanning for pelvis and legs, it could be seen that the bones and joints of the legs appear normal. The embalmed used two types of filling material in operations to keep the shape of the mummy and salts efflorescence appear clearly in the filling material within the body of the mummy, fig. (5). The salt efflorescence from abroad salts is unclear where the salt crystals have not been able to get out of the skin as a result of the embalmer's use of the wrapping of soaked linen in the molten resin and the fold on foot salt crystals, which lose their ability to access to the outside of the mummy. This is a clear risk as a result, because these crystals will move to fragile areas in the body to move out of the body with the continued storage of the mummy in the unsuitable environment will lead to continue pressure salts that engender the weaken of the mummy's body and increases the risk of the emergence of these salts in the areas of non-covered linen soaked in resin.

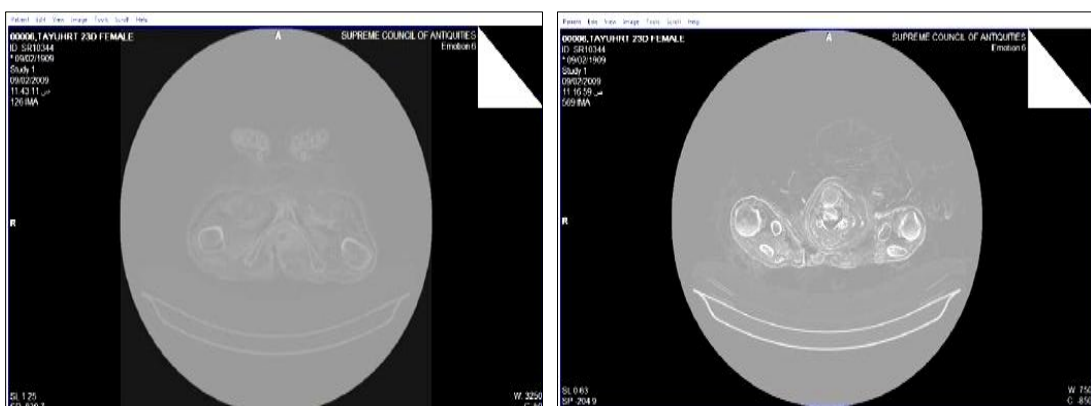


Figure (5) linen soaked resin filled the pelvis and the foot of the mummy's body.

6. Conclusion

*Through the current study some points could be concluded as follow: * CT scanner examination has become an indispensable tool for the noninvasive study of ancient Egyptian mummies. * Using a modern CT scanner gives a physical condition of how the mummy looks like and it shows how the skin and hair are well preserved. * The analysis with cutting edge CT scanners has given valuable insights into the embalming and burial processes without opening the cases and disturbing the body.*

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