

The Role of Computed Axial Tomography in the Study of the Mummies of Akhmim, Egypt

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Abstract

For more than a quarter century, computed axial tomography (CT) has given Egyptologists an increasingly sophisticated, non-invasive means of examining the interior of mummified bodies. What has been lacking from mummy studies to date is a regional focus confining itself to a single, defined population which makes its comparisons within narrowly defined limits of time and space. A study of Akhmimic mummies, hundreds of which entered the museum collections of Europe, America and elsewhere late in the 19th century, promises to greatly benefit the study of Egyptian mummification generally while gathering specific data on Akhmim's priestly population of the Ptolemaic period (332-30 BC). Recent CT examination of two female mummies from Akhmim has underscored the importance of considering features other than those on the traditional list of mummy contents. While amulets, visceral packets, and linen wadding have been noted for years, it is clear that they existed side by side with objects that, while difficult to classify, were equally deliberate and significant. The Akhmim Studies Consortium has been established to increase our knowledge of these poorly understood aspects of the embalming process as it existed at Akhmim and in surrounding locales.

Introduction

Scientific study of Egyptian mummies is entering its third century. It has progressed from the unwrappings (both public and private) of the Eighteenth and Nineteenth centuries to the autopsies and tissue analyses of the modern era.

Alongside these developments, X-ray photography and computed axial tomography scans stand as alternative ways of tapping the considerable biological and cultural information carried in the mummified remains of the ancient Egyptian population. The Akhmim Mummy Studies Consortium (AMSC) was established to help gather data from one subset of the ancient Egyptian community, those persons associated with the important city of Akhmim, located about 300 miles south of Cairo. Maspero (1893) mentions that over 800 mummies came to light during the earliest excavations at the site in March, 1884. Akhmim's numerous cemeteries were at that time hastily excavated; mummies brought to light were sold to travelers and subsequently entered museums throughout the world. Although Akhmimic mummies are known from a variety of periods, it appears at this time that the largest chronological grouping belongs to the Second Persian and Ptolemaic Periods (340 BC to 30 BC). AMSC is currently concentrating on that contingent of late mummies, many of which came to North America in the late 19th century. To date, AMSC has identified no fewer than twenty-five Akhmimic individuals in American and Canadian collections. The ancient names of many of these persons are known, and their genealogical profiles are often reconstructible. A large proportion of them belonged to Akhmim's religious community, both priests (sm3ty; hm ntr) and important female musicians known as sistrum-players of the god Min (ihyt n Mnw).

AMSC analyzes CT scans of Akhmim's mummies as the basis of its on-going comparative study of the ancient Akhmimic population. To date, three Akhmimic mummies of the early Ptolemaic period (3rd century BC) have been scanned and analyzed: AMSC 1 (Westminster College no. 48, [Pesed] female aged 55-65 years), AMSC 2 (Reading Public Museum 30.318.1, [Nefer-ii-ne] female aged 45-50 years) and AMSC 3 (College of Wooster 01.1a, [anonymous] female aged 35-45 years). All three women were members of Akhmim's priestly class who lived during the 2nd Persian Period or the early Ptolemaic era. Radiocarbon dating of linen from their respective mummies places the period of their deaths between the late 4th and the late 3rd centuries BC (AMSC 1 [linen, Beta 158338] 2290 +/- 40 BP; AMSC 2 [linen, Beta 189750] 2220 +/- 40 BP and AMSC 3 [linen, Beta 198852] 2230 +/- 40 BP). The radiocarbon dates are further supported by broad similarities in the design of painted cartonnage plaques and

masks placed on the mummies. AMSC 1 is equipped with a gilded, long-necked mask of thin cartonnage and two other painted cartonnage body plaques decorated with funerary symbols. AMSC 2 was equipped likewise, although her mask was a short-necked type possibly originally intended for a male. AMSC 2 also possessed a red cartonnage foot covering imitating feet wearing sandals; known as a "boot" this piece of equipment is a broad indicator of the Graeco-Roman period. The mask-less AMSC 3 was similarly equipped with a boot element

CT study of these three mummies is strengthened by experience AMSC personnel gained in the course of earlier CT scans of two Akhmimic priests in the collection of the Milwaukee Public Museum. These scans were carried out in the mid-1980s (Lupton, 1987; Notman and Lupton, 1995; Lupton 2001). These early scans revealed, for example, that CT was much more effective than conventional radiography in detecting objects of lesser opacity. Many objects indicative of mummification procedure, such as the smaller classes of the well-known visceral packets, were "virtually invisible" in conventional radiographs, but appeared clearly in cross-sectional CT slices (Lupton 2001). Drenkhahn and Germer (1991) obtained similar results during their CT study of a Ptolemaic period Akhmimic female in the collection of the Kestner Museum (Hannover, Germany). New data provided through CT showed that Egyptian embalming practices varied considerably from the late Third Intermediate Period to the rise of the Ptolemies (750-300 BC), particularly in the pattern of extraction, preservation and re-introduction of embalmed organs to body cavities. It is necessary to review the inference of O'Connor et al. (1980) that an absence of visceral packets in a given mummy (University of Pennsylvania E. 3413) indicates that embalming practices became more "simplified" as the Third Intermediate Period went on. Variety in the size, shape and location of visceral packets, for example, implies rather that funerary practices remained fluid throughout the later phases of Egyptian history. The panoply of evisceration and wrapping treatments discussed by Ikram and Dodson (1998) suggests growth in Egyptian funerary experimentation in the last few centuries BC.

Visceral packets

Analysis of the type and placement of visceral packets and other low opacity artifacts emerges as a critical part of new research on Akhmimic mummies. A previously unexplored dimension of the 'four packet protocol' of Ptolemaic times is the existence of four distinct classes of visceral packet, based on length: Class 1 (globular in shape and 10 cm and shorter); Class 2 (cylindrical in shape and 13-15 cm long); Class 3 (cylindrical and 19-22 cm long); and Class 4 (cylindrical and 25-28 cm long). Table 1 shows that visceral packets in the pelvic cavity typically belong to the smallest class (Class 1), perhaps only 60% as large as packets found higher up in the body. They are generally separated from the larger packets (Classes 2-4), which only rarely descend below the level of the iliac crest.

Placement of the larger packets (long rolled cylinders) is parallel to the spine and frequently these packets touch the spinal column. Contact occurs on the side of, or alternatively on top of, the spine. Packet placement that is diagonal in relation to the spinal column also occurs, but appears to be less frequent.

In AMSC 1, a large cylindrical packet (of Class 4) dominated in the upper left thorax, eclipsing the remaining thoracic packets in size (Class 2). These were placed toward the base of the thorax and continued into the abdomen. Earlier, Lupton (2001) had noted comparable left-thoracic placement of a large visceral packet in one of the Milwaukee Public Museum mummies from Akhmim, a Ptolemaic period male named Pedisherupakhered (MPM 10265). In this mummy, however, the other, smaller packets cluster as a trio in the mid-right thorax. It has been suggested that large rolled cylinders could be funerary papyri (Books of the Dead) placed directly inside the thorax (O'Connor et al. 1980). CT slices allow us to see, however, that the pattern of rolling is less convoluted than one would expect in a papyrus scroll. In light of this visual detail, and in consideration of endoscopic analyses available for Akhmimic mummies (Cockburn et al. 1975; Drenkhahn and Germer 1991), such packets are likelier desiccated lung and intestinal matter rolled twice or three times over into linen envelopes.

AMSC 2 contains four large packets of this kind (Classes 3 and 4), which are paired on either side of the spinal column. A class 4 packet is placed prominently in the right thorax. In AMSC 3, two large cylindrical packets (Class 3) cluster in the right thorax. 3D reconstruction shows that one has a smooth surface texture, while the other is bumpy (Fig. 1). A third packet of similar size crosses the spinal column diagonally. The left thorax is coated with resin but is otherwise empty. In this mummy, the placement of packets seems strongly directed toward the right thorax, and the packets seem to support an encapsulated granular mass (EGM) which fills the right-hand apex of the thoracic cavity (compare Vowles et al. 2004).

Another interesting feature of visceral packets is that while some are submerged in resin; others seem to have been more buoyant, and are not fully covered. Liquid resin was

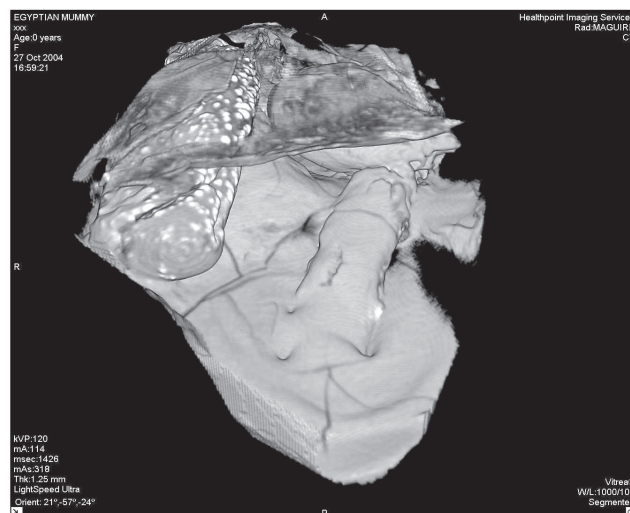


Fig. 1

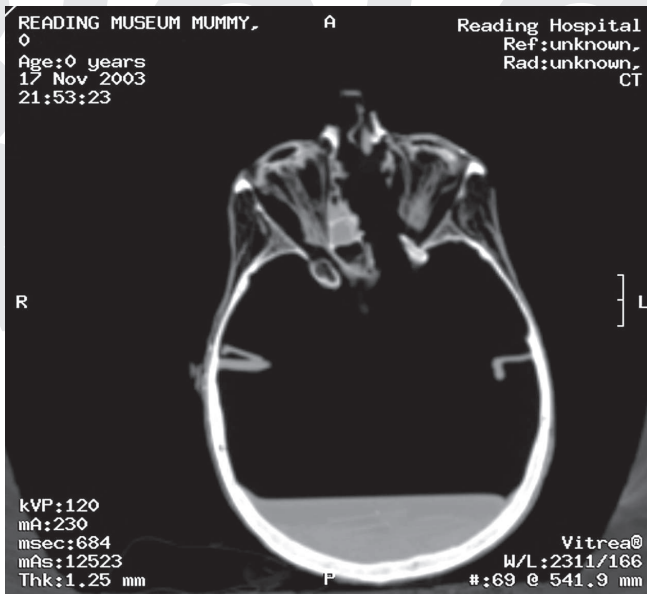


Fig. 2

poured into the body cavity after the insertion of the visceral bundles, following which, the embalming incision was plugged with cloth wadding. It is likely that each of the bodies was rocked back and forth to distribute the resin, resulting in a jostling of the packets.

Brain extraction

The route of entry for extracting the brain from the cranium was typically through the left nostril. There is substantial evidence that a hard (metallic?) tool had been used for this purpose as the cribriform plate that seals off the cranial cavity was generally perforated very efficiently. The brain tissue had been replaced by liquid resin. In AMSC 1, resin fills 50% of the cranium; in AMSC 2, a mere 25% and in AMSC 3 more than 65%.

Bandaging

The bandaging pattern is similar in each of the mummies. Cartonnage plaques are sewn to a linen shroud or over-cloth, which lies on a layer of resin that had been poured over the bandages making up the outer bundle. The arms and legs of each mummy were separately wrapped with thick layers of bandages prior to more generalized bandaging to create the mummy bundle. The CT-scans clearly reveal that these mummies had been wrapped in two distinct bandaging operations. In the first (innermost), limbs, neck and head were wrapped separately with seven or eight layers of bandages (about 2.5 – 3.5 cm thick). This was followed by an operation in which the body contours were obscured by transverse cross-bandaging, with an additional six or seven bandage layers (about 3.0 cm thick) which created a generalized mummy bundle resembling a cocoon. In AMSC 1 the bandaging density is uniformly tight. AMSC 2 exhibits greater density of wrapping of the left leg than the

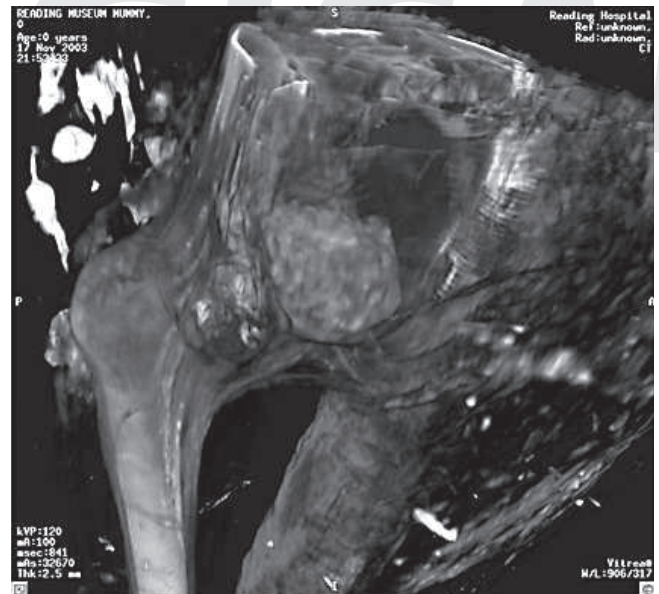


Fig. 3

right. Tighter wrapping of the left leg is indicated by the greater opacity in the CT scan image. In the scout view, the left leg shows a rather delicate in-turned aspect with a slight bend. The right leg is aligned more rigidly. Its looser bandaging may relate to the femoral injury suffered by AMSC 2 (see below).

Arm positioning

The arms of each mummy are crossed right over left, a practice that seems to have been quite frequent in Akhmim during the Ptolemaic Period and was perhaps a method of assimilating the deceased and Osiris, lord of eternity. The fingers of the right hand of each mummy are relaxed and lie upon the left shoulder. The left fingers of each mummy form a clutching gesture upon the right shoulder. Reserved for royalty in earlier times, this is by far the most common arm treatment seen in Akhmimic mummies of the late 4th - 3rd centuries BC.

Other treatments: pegs, plates, and poultices

A most remarkable aspect of AMSC 2's funerary preparation involved the pegging of replacement ears through the temporal bones on each side of her skull. The CT scan image (Fig. 2) shows clearly that narrow pegs, or possibly metallic pins, were inserted to attach the rectangular ear replacements. Since her head was originally fully wrapped, none of this special treatment would have been visible to mourners. The possibility exists that these replacement ears compensated for decomposition of ear tissue or insect infestation occurring during the desiccation phase of mummification; another possibility is that the ears are amuletic in function-compensating for hearing loss or deafness suffered by AMSC 2 during her lifetime. A mysterious plate (possibly of cartonnage) was tucked

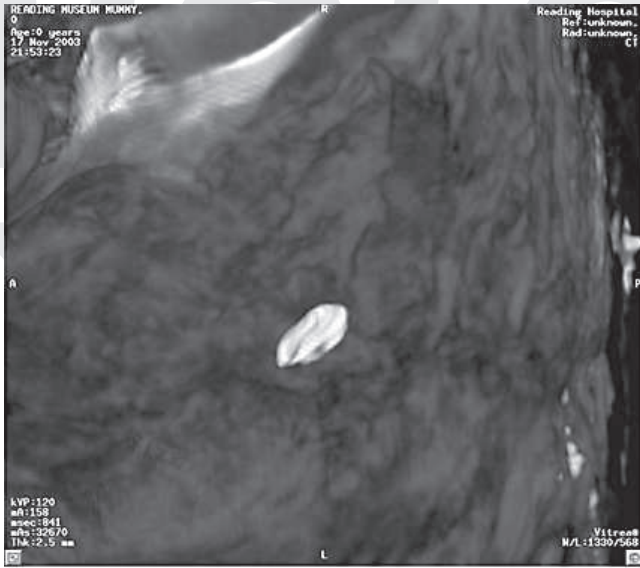


Fig. 4

under AMSC 1's left arm (between the first wrapping phase and the second). Examination in 3D reveals this plate to be embossed with a symbolic figure, possibly of the "Eye of Horus." Such plates are known elsewhere (e.g., Gray 1966), used as agents of magical protection or body regeneration, but finding one positioned under the arm is unusual. One possible interpretation is that the plate covered a painful area related to AMSC 1's final illness.

Steps taken in connection with the fracture of AMSC 2's femur are noteworthy. Healing of the fracture is evident: the bone of the femoral neck appears sclerotic (thickened to compensate for the injury), indicating perhaps that she kept moving after the break occurred. In contrast to modern practice, AMSC 2 had not been immobilized well enough to allow the bone to set during a post-injury survival period of about two months. A loss of joint space in the right knee may indicate that compression occurred in response to the hip injury.

AMSC 2's pelvic cavity contains one semi-spherical mass (5.14 cm right-left by 4.71 cm front-back) (Fig. 3). The CT scan reveals that the mass resembles a ball of textile (lower opacity, slightly unraveled), rather than, say, a scarab amulet (where one would expect high opacity and tight boundaries). What can be said, however, is that this mass is located in the abdominal cavity just opposite the head of the injured femur, directly above the right acetabulum of the pelvis. Its placement seems

deliberate and meaningful, as if it might be a poultice-like dressing contained within linen textile. It seems clearly intended to provide symbolic relief to AMSC 2's principal point of injury, if not to the precise locus of her discomfort.

An opaque mass appears in the bandages above the left ischial crest of AMSC 2's pelvis, in the direction of the left buttock. It is just below and behind the location of the embalming incision, an opening which was filled with linen wadding and then "glued" over with resin. At 1.45 cm in length, it is not at all large (Fig. 4). At this point in time we consider it a botanical object (perhaps a seed case or dried berry), which, given its deliberate placement on the right buttock, may have served an amuletic function.

Conclusions

The detection of significant low opacity features in Egyptian mummies is greatly aided by advances in 3D imaging software which is now part of normal CT technology. Through analysis of these features we have come to recognize that, alongside a standardized set of procedures, Egyptian mummification involved individualized treatments like those detected in all three of the mummies in this study. These treatments seem to take physical discomforts into account. In AMSC 1's case, a plate occurs under the

Mummy	Visceral Packet (VP) #	Location	Length	Orientation
AMSC 1 (AMSC 1) female	1.1	Thorax (L)	25.1 cm	Parallel and in contact with spine
	1.2	Thorax (L)	15.1 cm	Parallel to VP 1.1 against lower rib cage
	1.3	Thorax (R)	15.0 cm	On spine
	1.4	Pelv	9.0 cm	
AMSC 2 (Nefer-ii-ne) female	2.1	Thorax (L)	21.75 cm	Parallel and in contact with spine
	2.2	Thorax (L)	20.37 cm	Parallel to VP 2.1 against rib cage
	2.3	Thorax (R)	28.25 cm	Parallel to spine
	2.4	Ab/Pelv (R)	13.25 cm	Parallel to spine
AMSC 3 (Anonymous) female	3.1	Thorax	19.7 cm	Diagonal across spine (pointing up to right)
	3.2	Thorax (R)	21.0 cm	Parallel to spine and against rib cage
	3.3	Ab/Pelv (R)	19.0 cm	Upper end on spine; lower end against R iliac crest
	3.4	Pelv (L)	10.0 cm	Diagonal from left to center tucked below incision wadding

Tab. 1 - Visceral Packet Data from Three Akhmimic Mummies

left arm, positioned in response to ailments that may have led up to her death. In AMSC 2, a sphere has been placed, much like a poultice, against a fractured hip. The placement is not on the break itself, but where, presumably, she felt acute pain associated with the fracture. Individualized treatments also indicate a level of sensitivity on the part of funerary practitioners toward the persons on whom they were operating. It is doubtful that these elements would have been detected using conventional radiographs. Future studies of Akhmimic mummies by AMSC will examine closely such types of evidence.

The evidence presented in the CT scans of AMSC 1 and AMSC 2 suggests that dead Egyptians, at least in 4th – 3rd century BC Akhmim, were often treated much like living “patients” by the funerary specialists to whom they were entrusted. Injuries that could not be healed in time to save their lives, were attended to nonetheless during the preparation of their mummies. This effort was not wasted, for the evidence indicates that there was an abiding belief that death, while unavoidable, was merely a temporary transition which required careful attention to the future well-being of the dead.

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