MUMMIFICATION PRACTICES AT KELLIS SITE IN EGYPT’S DAKHLEH OASIS

Arthur C. Aufderheide
Larry Cartmell
Michael Zlonis
Peter Sheldrick

ABSTRACT

A total of 49 Late Ptolemaic-Roman Period mummies excavated from Kellis-1 cemetery at Ismant el-Kharab in Egypt's Dakhleh Oasis were examined by gross dissection in 1993 and 1998. Of these, 35 were sufficiently intact to reconstruct their mummification methodology. Most of these bodies had been looted at least once in antiquity with consequent damage to their integrity. The bodies of three bundles were found to be completely skeletonized. In the remaining 32, twenty had become mummified spontaneously secondary to environmental conditions. In these, some desiccated viscera were found within the body cavities. The remaining 12 had been mummified anthropogenically. These had been eviscerated, usually via an abdominal incision, and resin had been applied liberally, both internally and externally to these bodies. No evidence of natron desiccation was evident in either group. In many of each group, ancient efforts to reconstruct looted, fragmented bodies were encountered, both with and without the use of resin. Some reconstructions included resin introduction into the body cavities of spontaneously mummified bodies via atypical ports, while others involved the employment of body parts from more than one mummy. As a result, a total of seven distinct patterns of mummification were encountered among these 35 bodies. Familiarity with visceral alteration patterns that occur in spontaneously mummified bodies was key to unraveling the sometimes bizarre procedures inflicted on some of these bodies during postburial looting and mummy reconstruction efforts. The anthropogenic mummification methods were similar to those of contemporary burials in the Nile valley and at the Kharga Oasis.

KEY WORDS
mummification, Kellis, Ismant el-Kharab, Dakhleh Oasis, post looting reconstruction, transnasal craniotomy, resin, Duch

INTRODUCTION

The Geography and Description of the Kellis-1 Cemetery

The Dakhleh Oasis is one of a succession of geological depressions that lead northwestward through Egypt’s Western Desert beginning in its southeastern region not too distant from the Nile and ending at Siwa near the northern end of the Libya/Egypt border. Dakhleh is about 400 km west of the Nile at about the latitude of Luxor. The Kellis site at Ismant el-Kharab lies adjacent to the road from Kharga to Mut about 12 km east of Mut at about 25° 31’N, 29° 06’E. During the Roman Period the Kellis site represented an active trading center, surrounded by agricultural industry made possible by irrigation from the then still accessible water table. Kellis and the region relating to it probably supported a
population in excess of 1000 persons. Archaeological evidence has documented human occupation there from the Late Ptolemaic until about A.D. 400 of the Roman Period.

Materials and Methods

Two burial sites have been identified within the Kellis site. A Romano-Byzantine Period cemetery, Kellis-2, consists of largely skeletonized bodies while many of the bodies in the other, Kellis-1, are mummified. Kellis-1 consists of a succession of at least two dozen small tombs cut into the face of a sandstone terrace, 21 of which have been excavated to date. These tombs occupy an area of about two or three square meters and the floor-to-ceiling height only occasionally exceeds about one meter. Two upright stones on each side of a low, narrow adit support a stone lintel, and the entrance opening normally is closed by a coarsely rectangular rock (Photograph 68).

The tombs' description and their contained mummies are presented in a separate report (Aufderheide et al., 2004) where all 49 mummies and their individual features are listed. The 15 mummies examined during the 1993-1994 season have been published (Aufderheide et al., 1999). An additional 34 mummies were examined during the 1998-1999 season. Findings from these shed further light on mummification practices at Kellis site during the Roman Period. They explain some of the confusing observations made during the 1993-1994 season, and their significance is discussed herein. Torn wrappings, disarticulated heads and extremities, fragmentation of mummified bodies and commingled, disarticulated bones are all abundant in these tombs and testify to extensive looting in antiquity (Photograph 69).

Spontaneous vs. Anthropogenic Mummification

Mummification mechanisms can be grouped into two major classes: spontaneous and anthropogenic. Spontaneous mummification is the product entirely brought about through the action of certain environmental ("natural") conditions extant at the time of burial. In contrast, anthropogenic ("artificial") mummification occurs as a result of some deliberate human actions carried out usually immediately after death that are specifically designed to enhance long-term preservation of soft tissue. In Egypt spontaneous mummification generally occurs by dehydration of the body, thus paralyzing the action of decay enzymes whose effect requires a certain minimum water content. This spontaneous process of desiccation is achieved principally by high summer temperatures.

Features of Spontaneous Mummification. Many of the visceral organs become desiccated so rapidly that much of their structure may be retained. The spleen, an organ composed principally of fragile blood cells, often decays completely. Lungs are most commonly preserved, and in a supine body deflate completely, collapsing and contracting into a flat structure often less than two centimeters thick, lying on the posterior surface of the thoracic cavity’s inner lining and conforming to the curvature of the posterior rib cage. Epithelial cells decay rapidly after death. Although the liver is made up almost entirely of glandular cells, its huge size during life (one and one-half kilograms) usually results in a smaller but still prominent structure in a spontaneously mummified body. The blood-filled heart suspended in a fluid-filled pericardial sac dries more slowly and survives the postmortem process only when preservation conditions are ideal. These and other organ changes thus create a pattern of visceral organ preservation in spontaneously mummified
bodies that becomes familiar to those with experience in dissection of such mummies (Aturaliya and Lukasewycz, 1999; Aufderheide, 2003:316-321).

Features of Anthropogenic Mummification. In Egypt anthropogenic mummification evolved via modification of several features over the 3000 years of its history. In the Archaic Period it became evident that mere wrapping of the body often was insufficiently effective to prevent decay. Eventually desiccation of the body was achieved by initial evisceration followed by envelopment of the body in powdered natron, an ore composed of carbonate, bicarbonate and chloride salts of sodium. Body water was removed by the osmotic effect of these chemicals, and prevention of subsequent rehydration was achieved by coating the external and internal body surfaces with a layer of hot resin that hardened upon cooling, providing a water-repellent shell. During later periods of Egyptian history, increasing reliance was placed on more extensive resin application and decreasing use of natron. Egyptian evisceration usually did not remove the heart and often permitted the kidneys to remain in the body as well (Ikram and Dodson, 1998:103-136).

Both spontaneous and anthropogenic mummification methods were identified in the mummies removed from the Kellis-1 cemetery.

FINDINGS AND THEIR INTERPRETATION

Post-Burial Outcomes Identified Among Kellis-1 Mummies

Seven different methods of corpse alterations were identified among the Kellis-1 mummies. Their description follows.

Type 1. These represent completely skeletonized bodies usually presenting as a group of completely disarticulated bones. Many of them were scattered and commingled so extensively in the tombs as to frustrate regrouping into individual bodies. They contained no attached soft tissues. Their disassembly appears to have been the product of artifact-seeking looters in antiquity (Photographs 70 - 71).

Type 2. In a few cases an effort had been made by someone to refashion and rewrap these disarticulated bones into something externally resembling a mummy bundle (Photograph 72). Mummy 15 is such an example and is detailed in Aufderheide et al. (1999). Of interest here is the fact that the individual bones had been lashed into roughly anatomic position on a wood frame (Photograph 73). Furthermore the “body” was composed of body parts from four different individuals (the head and trunk of two different adults and the legs of two different children) (Photograph 74).

Type 3. This was simply the desiccated, spontaneously mummified body of an adult female in whom no human effort at soft tissue preservation was apparent (Photograph 75).

Type 4. These bodies were identical with those of type 3 with one exception: a very thin layer of black resin had been painted on the external skin surface only (Photographs 76 & 77). It is not possible to be certain whether this resin was applied at the time of burial or after looting and rewrapping was carried out (or both).

Type 5. These bodies had originated as type 4 bodies. However, after being looted, reconstruction efforts involved introduction of hot, liquid resin into the body cavities but through atypical resin ports. Normally in New Kingdom mummies of the Nile Valley resin was placed into the body cavities via the same incision that had been made to remove the viscera. The incision was commonly made in the abdomen or, exceptionally, in the perineum. In type 5 Dakhleh bodies, however, the resin had been introduced via a defect in
the back (Photographs 78 & 79), in the anterior chest wall or by being poured into the mouth and trachea. Thus these bodies had originally become mummies by spontaneous mummification, were looted and during reconstruction had extensive resin applied internally via atypical portals after which they were rewrapped. The process of resin application techniques had been executed crudely.

Type 6. At time of death these bodies had been prepared with professional finesse to prevent soft tissue decay. Evisceration had been carried out via a left-sided abdominal incision (Photograph 80) and in a few via the perineal route, followed by extensive resin application to both the skin surface and to the body cavity lining. The abdomen was filled with rolls of resin-soaked linens (Photograph 81). Body orifices were occluded by small fragments of linen saturated in resin. No evidence of natron use was apparent.

Type 7. Bodies in this category were prepared with professional skill precisely as were those of Type 6. These, however, were subsequently fragmented by looters and later were reconstructed and rewrapped. The reconstructions frequently involved splinting the body parts with wooden sticks fashioned from the spine of a palm leaf (Photograph 82). Just as in Type 2, occasional mummies of this type were composed of body parts from more than one body.

INTERPRETATION OF MUMMIFICATION FINDINGS

Why did Type 1&2 bodies not mummify?

In Types 1 and 2 the soft tissues decayed completely. This occurred in roughly half the bodies found in these tombs. If no effort is made to preserve soft tissues immediately after death, the race between the decay process and those environmental factors favoring preservation commonly is a close one. Relatively small variations such as temperature, time interval between death and burial, major infection at time of death et al. may tip the balance toward either skeletonization or spontaneous mummification. For example, many of the individuals whose body skeletonized after death may have died during the winter months when temperatures were not high enough to enhance desiccation. Thus these bodies may have been treated no differently after death than were those of Type 3, but environmental conditions determined whether skeletonization or spontaneous mummification became the end product.

What was the function of the externally-applied resin in Type 4 mummies?

A large fraction of the examined Type 4 mummies showed an organ preservation pattern characteristic of spontaneous mummification. Yet, with one exception (Mummy no. 6, Photograph 75), the mummies in this classification were all given a thin coat of resin on the skin surface only (Type 4). Resin has no intrinsic desiccating properties. The purpose of its use in mummification has never been defined in ancient papyri or inscriptions, though its employment as incense, cosmetics and perfumes is documented (Newman and Serpico, 2000:480). We can speculate, however, from our knowledge of its features. When applied to a desiccated surface, it was painted or wiped onto the tissue while very hot to permit its application while it was still liquid. The resin’s temperature itself at time of application was probably high enough to be bactericidal. Furthermore, Majno (1975:217) carried out laboratory studies which demonstrate that some resins have substantial biological antibacterial properties. In addition, upon cooling, many resins harden into a crystal-like
structure. This feature often led to resin being exploited as an adhesive substance to help retain bandages in position. When applied to the lining of the body cavity following evisceration and washing with palm wine (12% ethanol), resin could contribute preservation further by destroying whatever bacteria survived up to this point. Note, however, while it has no known desiccating properties, a thick layer could help prevent rehydration of already desiccated tissue.

What value, then could the sometimes almost transparent layer of resin have had when painted on the skin surface in Type 4 bodies, since the amount applied was insufficient in this group to penetrate into the deeper tissues? Given its known features, we can suggest only four possibilities:

1. It could have helped to decrease the number of bacteria on the skin surface;
2. It may have been a relic practice, effective in protecting a natron-desiccated body from rehydration when applied in generous quantities during the New Kingdom, but in these Type 4 mummies the practice may have persisted near the terminus of Egyptian history as a symbolic, probably religious ritual.

Lucas (1948:324) observed that...“resin was also employed where it served no useful purpose and where, therefore, it probably had a ritual significance...”, and goes on to cite an example.

Serpico and White (2001) investigated the chemical nature and the use of black pigment on funerary items. While such “varnish” had multiple, variable components, its base usually consisted of resin, sometimes accompanied by bitumen. This was commonly applied to Egyptian coffins, ushabti and mummies. The Egyptian word snTr was applied to this material which is usually translated as incense, and chemically resin most commonly proved to be pistacia resin. They note, however, that when this material is used to line ceramic pots and funerary furniture, it was obviously not intended to be burned, and therefore in these circumstances it is better to use the more literal meaning of that Egyptian word “that which makes divine.” Thus, resin applied to the coffins, funerary wooden objects and mummies may have been used to make these items (including the mummies) divine. They cite a scene from a tomb in Thebes interpreted as a priest overseeing the varnishing of a coffin. In brief, these authors’ observations suggest that the thin, superficial resin coat of Type 4 mummies may have been designed to assist the deceased to become eligible for inclusion in his “...divine afterlife...”

3. The sticky, adhesive nature of cooling resin could help to hold in position the broad sheets of wrapping linen that were routinely applied directly to the skin as the first layer of wrappings in the Dakhleh mummies. Lucas (1962:7-8) has also suggested that resin was employed in ancient Egypt for general adhesive purposes.

4. Resin may have an insect-repellent effect. These mummies certainly were not devoid of insects. We found resin-embedded insects in several cranial cavities and in the thoracic cavity of one. Nevertheless, we found few of the many insect perforations that are so common in the skin of spontaneously-mummified bodies that are not processed in any way and buried without coffins under many circumstances. It is conceivable, though untested, that resin, sometimes mixed with bitumen (as the mummies reported in this article have been shown to be—Maurer et al., 2002), beeswax or other, unknown compounds may have repelled insect destruction,
providing time for the dehydrating environmental factors to effect desiccation. If the preparation and application of such a resin mixture was part of a ritual, its insect-repelling effects may even have been unintentional.

Of these possibilities the last three are most appealing and are not mutually exclusive. The resin applied to the skin certainly did not prevent the spontaneous desiccation type of mummification pattern of the internal organs in Type 4 mummies.

**Why was resin introduced into the body cavities via such atypical entry sites of Type 5 bodies?**

In several of these, hot resin had been introduced through a defect in the lumbar area of the back. Tissues of the back muscles in this area obviously at some point had been disrupted (during lootings?) and broken into multiple, irregular chunks averaging about 5-6 cm in diameter. These had been replaced and held in position by using resin as an adhesive substance. The remaining defect was employed to pour a large amount of liquid resin into the body cavities. The back opening was then sealed by stuffing a mass of resin-soaked linen into the remaining, gaping defect (Photograph 78). This resin pooled within the body cavities over the inner aspect of the sternum (Photograph 79) and also the inner aspect of the anterior abdominal wall, providing proof that such several bodies were in a prone position when resin entry occurred. Yet, in one of such bodies (Mummy 110) the intact, desiccated lung was flattened against the posterior inner lining of the thoracic cavity as occurs in spontaneous mummification in a supine body. Clearly this body initially had become mummified spontaneously. At a later time, probably after being unwrapped and damaged while being looted, the body was discovered. Reconstruction attempts were then made that included abundant resin introduction into a body already spontaneously mummified, and that was then rewrapped. The purpose of the resin in these bodies is not clear but may have been similar to that for Type 4 bodies or simply to create a barrier between the exposed tissues and insects.

In other Type 5 bodies resin was introduced through a small defect in the left subclavicular area of the thoracic wall, and in another the hot resin was poured into the open mouth, flowed down into the bronchi and then penetrated the intact, spontaneously desiccated lung tissue and reached the body cavities. No evidence of an evisceration wound (neither abdominal nor perineal in type 5 mummies) could be found, and all Type 5 bodies had some stigmata of the visceral preservation pattern that is characteristic of spontaneous mummification. A numerical evaluation of Type 5 bodies (see below) indicated these seven bodies had been correctly interpreted as Type 5 bodies.

**How do the Type 6 and 7 mummy preparation methods at Dakhleh compare with those of the Nile valley?**

Detailed survey data on Roman Period mummies of non-elite persons in the Nile valley are not readily available. By combining reports of individual or small groups of such bodies, some generalizations seem possible (Ikram and Dodson, 1998:129-131). Features of these include the following: considerable variations are apparent; evisceration is less frequently carried out; natron desiccation is often absent; resin application internally and externally is present in abundant quantities; portraits painted on wood and included in the
wrappings are found in a small percentage of Roman Period bodies in the Nile Valley; among the elite, great effort was employed to present an attractive (often geometric) wrapping pattern on the superficial layers of the mummy bundle.

Most of these are also features of the Dakhleh mummies Types 6 and 7. All were eviscerated via incisions (mostly abdominal) placed in precisely the same location as those in the Nile valley. None had mummy portraits, though the proportionately small number that did have in the Nile valley negates this as a differentiating feature. Thus, the features relating to professional expertise among the Dakhleh Types 6 and 7 and the Nile valley mummies were indistinguishable, though none of the superficial wrappings demonstrated geometric patterns such as were present in some Nile Valley elite bodies.

The significance of transnasal craniotomy

Transnasal craniotomy (TNC) is the term we use for the defect commonly created by Egyptian embalmers when they inserted a metal rod into the nares (Photograph 83) and pushed it upward with force sufficient to break through the cribiform plate of the ethmoid bone into the cranial cavity (Smith, 1902; Sudhoff, 1911) (Photograph 84). Herodotus (II. 86) attributes the purpose of this procedure to removal of the brain. This defect is easily identified and has been found in a few Middle Kingdom bodies (Strouhal, 1986), and in most Egyptian mummies after that time. Although Herodotus (Book II:86) described the use of an iron rod with a hook to remove the brain through such a defect, modern experimentation has concluded that the rod may have been employed to macerate the brain by twisting and moving the outer end in a wide, circular manner (Leek, 1969). Experimental work by Garner (1986) has demonstrated that insects can penetrate up to 15 or 30 centimeters of powdered natron to reach soft tissues after death.

With two exceptions (mummy 117 – an isolated adult head, and mummy 132, a Type 6 child aged 4 years) all of the Dakhleh mummies with related heads had evidence of TNC, a frequency of 94%. However, of 36 skulls from skeletonized bodies in these tombs (the majority from tomb 13), only 3 (10%) revealed evidence of TNC. This suggests that the ultimately skeletonized bodies were viewed differently at the time of burial by those responsible for their interment than were the bodies that became either spontaneously or anthropogenically mummified. Whether that difference was based on economic or other factors cannot be established archaeologically for these mummies.

INDIVIDUAL FEATURES OF MUMMIFICATION AT DAKHLEH

Soft Tissue Preservation

We have created a simple system not involving detailed measurements to estimate preservation of skeletal and soft tissues in mummies (Aufderheide, 2003:335). Twenty points are assigned each for the head, both arms, both legs, chest and abdomen. These values total 100 if all bones are present (BP: bone preservation), and also 100 if each of these respective body regions are covered with soft tissue (STP: soft tissue preservation). Then STP/BP = STI (soft tissue index) that expresses the fraction of the skeleton that is covered by soft tissue. These crude values can be estimated in the field by simple inspection, yet they express information at a useful level. The values at Dakhleh were BP = 63.8, STP = 51.7 and STI = 81.0, indicating that a mean of about two-thirds of the skeleton was present, about 80% of which retained its soft tissue. Grouping of the individual values by age
(subadults vs. adults) and by sex revealed no statistically significant differences in soft tissue preservation.

Visceral Organ Preservation

The various body organs (heart, lungs, kidneys, liver, spleen, hair, bladder, intestine, penis or breast, prostate or uterus and ovaries) were assigned 10 points each; if all were preserved the total organ preservation score (OPS) was 100. Of 42 mummies that could be so evaluated, no statistically significant differences were evident in values between the sexes (male 23.8, female 20.0). Table 1 relates the OPS to mummification styles. As could be expected, the OPS approached zero value in the nearly skeletonized mummification styles (Type 1 & 2), demonstrated mean values in the thirties for spontaneously mummified styles (Types 3, 4 & 5), and low values for the eviscerated, anthropogenically mummified styles (Types 6 & 7). The significance of this table for our examined mummies lies in the value for Type 5. As noted above, assignment of a mummy to this type implied initial spontaneous mummification with extensive internal resin applied later through atypical resin ports during reconstruction following looting. The mean OPS value of mummies we assigned to the Type 5 group is indistinguishable from those of the spontaneously mummified Types 3 & 4, providing assurance that the Type 5 mummies had been correctly classified as spontaneously mummified in spite of the large quantity of resin present in their body cavities that had presumably been applied during reconstruction efforts.

Selection of Mummification Styles

Since few artifacts remained with the mummies in these tombs and since looting with its associated body disarticulation and fragmentation commonly frustrated the assignment of masks, pectorals and other items to specific bodies, little opportunity is available to assess the status of individual mummies. However, chi square tests revealed no statistically significant difference between the 6 of 15 males and the 6 of 12 females chosen for the most elaborate, anthropogenic mummification Types 6 and 7. Chi square tests also reveal that those who interred the Dakhleh bodies did not discriminate in mummification style choices on the basis of age (subadults vs. adults). Finally, whatever criteria operated to influence choice of mummification style, they seemed to be consistent over the time period of the first 21 caves excavated. The numbers assigned to mummification styles are arranged in numerical sequence in relation to increasing complexity of mummification techniques. Simply totaling the mummification type numbers in a group of mummies and determining the group mean value provides a measure of mummification complexity for the group. By grouping mummies into those from tombs 1-12 (mean mummification number value = 4.18 ± 1.78, N=11) and those of tombs 13-21 (mean 5.10 ± 1.51, N=21), we find no statistically significant difference between these two groups. This result would be consistent (though not verifiable) with the suggestion that professional embalmers were not always available at time of death in this remote oasis.

Comparison of Dakhleh & Duch (Kharga) mummies. Until analyses of the recently discovered group of mummies found in the Bahariya Oasis (Hawass, 2000) have been reported, mummification at Dakhleh can be compared with those at other sites remote from the Nile only at the Duch site in Kharga Oasis (Dunand et al., 1992). There 72 graves yielded 562 bodies of which about one-half were mummified. To date these have not been
dissected. However, 50 were selected for radiological study. In most of these the wrappings had already been extensively damaged by looters and so the remaining bandages of these 50 were completely removed. Observations made possible by external inspection and by carefully controlled but plain, portable radiography have been reported (Lichtenberg, 1994). In some mummies this can produce highly useful information. However, in completely desiccated bodies the tissue density differences between the various viscera can be dramatically reduced, sometimes rendering entire organs invisible in plain radiographs (Aufderheide, 2003:379; 383 Fig. 6.48). Table 2 demonstrates both similarities and differences between the Dakhleh and the Kharga mummies. Both groups were characterized by spontaneously and by anthropogenically mummified bodies that had been looted extensively. Their time periods were similar, though some bodies at Duch were from a much later period. Skull fractures at Duch were also much more common. Resin in the cranial cavity was a common feature of the Duch mummies, though only rarely seen in those at Dakhleh. Several Dakhleh skulls also demonstrated clearly that resin had reached the cranial cavity by being poured into the abdomen, the hot, liquid resin flowing through intervertebral foramina into the spinal canal and then up into the cranium via the foramen magnum. Although much more data will become available if and when the bodies from Kharga are dissected, it can be stated that the mummification patterns at Dakhleh and at Kharga have similar qualitative features but differ quantitatively. In addition, the peculiarities of the reconstructive efforts that are so striking at Dakhleh appear, with one exception, to be absent at Duch.

**DISCUSSION**

At the Kellis site in Egypt's Dakhleh Oasis during the Greco-Roman Period, the Kellis-1 cemetery indicates that some of the bodies had been placed in the tombs with little or no effort to prevent postmortem decay of the soft tissue, while others underwent evisceration and extensive resin application but no evidence of natron desiccation. A substantial fraction (not yet precisely established) of the former underwent decay to the point of skeletonization and disarticulated dry bones. In the remainder, desiccation occurred as a consequence of environmental conditions sufficiently rapidly to arrest decay. The absence of subsequent rehydration resulted in long-term spontaneous mummification of these bodies (Photograph 77). In addition, the eviscerated bodies with both external and internal liberal application of resin at time of burial survived the subsequent postmortem environment very well, demonstrating little evidence of soft tissue loss following the embalming process at time of burial. It is conceivable that the very thick layer of hot resin in direct contact with the soft tissues of types 6 and 7 transferred sufficient heat to those soft tissues to result in protein denaturation (“cooking”), contributing to their preservation.

After inhumation, most of these bodies were extensively altered by subsequent looting. Evidence for this lies in the bodies partially or completely shorn of their linen wrappings. When not completely stripped of the enveloping linen, the crudely torn wrappings usually exposed the face and, in some, also the chest, neck, arms or even legs. This pattern corresponds to the hair, face, neck, pectoral, arm, wrist and ankle body areas that are common sites for body adornment with jewelry. This is further confirmed by the fact that the mummified bodies were often fragmented in a manner to provide access to these areas and to accommodate artifact removal. Thus we often find that the head has been
separated from the body (frequently by twisting it), the arm torn from the shoulder and the hands and feet broken and disarticulated. The individual bones of skeletonized bodies found when looters stripped the wrappings were commonly scattered and commingled in the tombs. That these tombs were looted repeatedly is evident in some reconstructed bodies whose wrappings had been partially removed.

Of great interest is the obvious effort consumed in reconstruction of these looted and damaged bodies. These reconstructive efforts are responsible for the great variety of mummification patterns found in these tombs. Such efforts even included the disarticulated bones of skeletonized bodies, in which the individual bones were lashed to a wooden rack in roughly anatomical position. Those persons effecting such reconstructions apparently were sometimes confused by the commingled state of such bones and so used whatever parts were available to complete their reassembly of the body. This resulted in the production of composite mummies, such as Mummy 15 and some splinted bodies of mummification Type 7 that were made up of body parts from several different mummies. The most difficult to evaluate were the reconstructed spontaneously mummified bodies of Type 5 in which liberal amounts of resin were introduced during reconstruction into the body cavities via atypical resin ports. Familiarity with visceral alteration patterns seen in spontaneously mummified bodies were key to deciphering the procedures inflicted on these bodies subsequent to their original burial.

It is useful to reflect for a moment on the major effort expended in many of these reconstructions. The cost of the wrappings and of the large amount of resin employed in some of these is so substantial that the presence of an intact body presented in an appropriately-wrapped bundle must have had profound meaning to those carrying out these reconstructions. This is particularly emphasized by the fact that it must have been obvious to those repairing these bodies that they had no assurance the reconstructed bodies would not be looted again (in fact, some were). It is also revealing that the relatively crude nature of the reconstructions stands in vivid contrast to the professional expertise with which the anthropogenically mummified bodies of Type 6 were prepared.

In general the inhumations at Kellis-I could be divided simply into the two groups characterized by spontaneous and by anthropogenic mummification. If, however, we concentrate on the virtual absence of both TNC and resin in the skeletonized bodies, these could be considered an additional category. Several possible explanations could be offered for the differing forms of body preparation before burial. The most obvious of these could be cost. While Dakhleh was an active trading center, there is limited evidence of affluence in this community. Mortuary products were probably even more expensive in this community that was remote from the Nile valley. Certainly property managers such as the author of the Kellis Agricultural Account Book (Bagnall, 1997), those in the clerical hierarchy, and merchant traders could be expected to afford the extensive preparation necessary for anthropogenic mummification that was similar to the most skilled embalming feats of the Nile valley. However, much of the resident population was probably living the life of the fellahin. Thus, expense of the mortuary treatment may well explain the differences in body preparation.

A second possibility may be limited availability of professional mortuary expertise in a relatively small, isolated community like Kellis. The high quality of the Type 6 bodies is evidence of availability of professional embalmers at Kellis on at least some occasions.
However, sudden, unexpected death at Kellis could have occurred when such embalmers were occupied with other deaths in more distant communities, allowing few options other than burial without elaborate preparation. Finally, those buried with no or minimal body preparation may have embraced religious convictions that did not value soft tissue preservation of the body. Differentiation of these possibilities will need to await further studies that might help assess social status of individual burials and a greater database dealing with the character of Kellis' resident population.

(In order of authors listed at beginning of article)
-Paleobiology Laboratory, Dept. of Pathology, University of Minnesota School of Medicine, Duluth, MN  55812
-Dept. of Pathology, Valley View Hospital, Ada, Oklahoma
-Dept. of Pathology, St. Luke’s Hospital, 905 East First Street, Duluth, MN  55805
-11 Victoria Avenue, Chatham, Ontario  N7L 2Z7

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TABLE 1. ORGAN PRESERVATION VS. MUMMIFICATION STYLES.

<table>
<thead>
<tr>
<th>Mummification Style</th>
<th>Organ Preservation Score (OPS)</th>
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<th>Body Preservation</th>
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N = number of mummies, S.D. = one standard deviation.
### TABLE 2. COMPARISON OF MUMMIFICATION FEATURES OF DAKHLEH AND KHARGA OASES.

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<thead>
<tr>
<th>Item</th>
<th>Dakhleh (Kellis)</th>
<th>Kharga (Douch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mummies examined</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>Time Period</td>
<td>Late Ptolemaic-Roman</td>
<td>Ptolemaic-AD 900</td>
</tr>
<tr>
<td>Looting</td>
<td>Extensive</td>
<td>Extensive</td>
</tr>
<tr>
<td>Wrappings</td>
<td>Torn</td>
<td>Torn</td>
</tr>
<tr>
<td>Evisceration</td>
<td>36%</td>
<td>10%</td>
</tr>
<tr>
<td>Atypical resination</td>
<td>19%</td>
<td>2%</td>
</tr>
<tr>
<td>Circumcision</td>
<td>38%</td>
<td>15%</td>
</tr>
<tr>
<td>TNC</td>
<td>94%</td>
<td>65%</td>
</tr>
<tr>
<td>Skull fractures</td>
<td>None</td>
<td>Many</td>
</tr>
</tbody>
</table>

Data for Kharga mummies were extracted from Lichtenberg, 1994.
TABLE 3. VISCERAL INDEX.

<table>
<thead>
<tr>
<th>Value</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Heart</td>
<td>Heart</td>
</tr>
<tr>
<td>10</td>
<td>Lungs</td>
<td>Lungs</td>
</tr>
<tr>
<td>10</td>
<td>Spleen</td>
<td>Spleen</td>
</tr>
<tr>
<td>10</td>
<td>Kidneys</td>
<td>Kidneys</td>
</tr>
<tr>
<td>10</td>
<td>Bladder</td>
<td>Bladder</td>
</tr>
<tr>
<td>10</td>
<td>Intestine</td>
<td>Intestine</td>
</tr>
<tr>
<td>10</td>
<td>Prostate</td>
<td>Uterus</td>
</tr>
<tr>
<td>10</td>
<td>Penis</td>
<td>Breasts</td>
</tr>
<tr>
<td>10</td>
<td>Hair</td>
<td>Hair</td>
</tr>
</tbody>
</table>

Up to 10 points are assigned for preservation of each of the listed viscera. The visceral index is the sum of the points assigned to each organ (Aufderheide, 2003:332).