



MYCENAE REVISITED PART 3. THE HUMAN REMAINS FROM GRAVE CIRCLE A AT MYCENAE. BEHIND THE MASKS: A STUDY OF THE BONES OF SHAFT GRAVES I-V

Author(s): Lena Papazoglou-Manioudaki, Argyro Nafplioti, J.H. Musgrave and A.J.N.W. Prag

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MYCENAE REVISITED PART 3. THE HUMAN REMAINS FROM GRAVE CIRCLE A AT MYCENAE. BEHIND THE MASKS: A STUDY OF THE BONES OF SHAFT GRAVES I–V¹

1. INTRODUCTION (BY A.J.N.W. PRAG)

IN *BSA* 104 we described how the ‘Mycenae Revisited’ project came into being, how the rediscovery in the National Archaeological Museum in Athens in 2003 of two skeletons excavated in 1877 by Stamatakis in Shaft Grave VI at Mycenae led to a proposal to study those remains in detail and to reconstruct their faces, and how this in turn spawned a number of other projects (‘Mycenae Revisited Part 1’: Papazoglou-Manioudaki *et al.* 2009). The first of these follow-up actions—‘Mycenae Revisited Part 2’—was a study of the remains of the majority of the individuals from Grave Circle A (GCA) by strontium isotope analysis, intended to discover their geographical origins (Nafplioti 2009). The next, a catalogue and full reappraisal of the skeletal remains from the other graves in Circle A, is presented here in the context of their recovery with the associated finds. At the time of writing two more articles are planned, one considering the problem of the ‘mummy’ from Shaft Grave V (Part 4) which is touched on below, and finally as ‘Mycenae Revisited Part 5’ a reassessment of the occupants and the use of the graves in Circle A in the light of the new discoveries.

Alongside these articles is another series describing the study of the DNA from Mycenae as part of an investigation into kinship relations within and between the two grave circles and in a wider Greek and Minoan context (Bouwman *et al.* 2008; Bouwman *et al.* 2009; Chilvers *et al.* 2008). While that research confirmed a brother–sister pairing in grave Gamma in Circle B that had already been suggested through facial reconstruction (Prag *et al.* 1995; Prag and Neave 1997, 105–45), it also showed that the remains from Circle A were at the limits of the timespan over which one could expect the DNA to survive, and that in any case they had been too long out of the ground to deliver any valid results.

Reassessing and identifying the all too fragmentary skeletal remains from Schliemann’s excavations in GCA, alongside Stamatakis’s role in their recovery and recording, has involved reconsidering the story of the artefacts from the graves, here carried out by their curator, Dr Lena Papazoglou-Manioudaki. This is not a full republication of those many objects, of course, and hence we have only included sufficient references to set the scene and provide a context.

The final section of this article comprises the first complete morphological analysis of the human skeletal material recovered by Schliemann and Stamatakis from Shaft Graves III, IV, and V, thus completing the analysis begun in ‘Mycenae Revisited Part 1’ with the skeletal

¹ Dr Papazoglou-Manioudaki’s co-authors would like to acknowledge her enthusiastic help and support and that of her colleagues at the National Archaeological Museum in instigating and helping us carry through this project. We are also most grateful to the *Annual’s* referees, in particular to Dr Sevi Triantaphyllou for her very helpful

and informed comments: having read the article in an earlier format, she then kindly did so all over again when it was resubmitted. FIGS. 1–14 are reproduced courtesy of the National Museum; FIGS. 15–31 are the work of Dr Nafplioti.

material from Grave VI. There is no material available at present from the remaining two graves (I and II). This study is primarily the work of Dr Argyro Nafplioti: in addition to providing a catalogue and description of the remains, a determination of the number, the biological sex, and the age at death of the individuals represented, a description and interpretation of pathological skeletal modifications, it seeks to find evidence for occupational stress. We appreciate that such an approach may cause scepticism among some more traditional osteologists, but if you don't look you don't find.

2. SCHLIEMANN, STAMATAKIS, AND THE EXCAVATION OF GRAVES I–V AT MYCENAE (BY LENA PAPAZOGLU-MANIOUDAKI)

The enduring legacy of the Shaft Graves is the impressive wealth of the grave furnishings, still at the focus of the Mycenaean scholarship they initiated. The actual anthropological remains of those buried in the Shaft Graves did not attract much attention over the years. J.L. Angel studied the bones in the National Museum in 1937 and left a copy of his scientific report in the archive of the National Archaeological Museum, but it remained unpublished until 1973 (Angel 1973, 384). This article, the third in the series 'Mycenae Revisited', attempts to combine the scanty information given by Schliemann in his book *Mycenae* (1880) and the insights acquired by a study of the reports of Stamatakis (Papazoglou-Manioudaki *et al.* 2009) with the facts of a thorough anthropological study. The aim is to create a more real picture of the persons buried with such rich furnishings in Shaft Graves I to V and, whenever possible, literally to identify the person behind the gold mask.

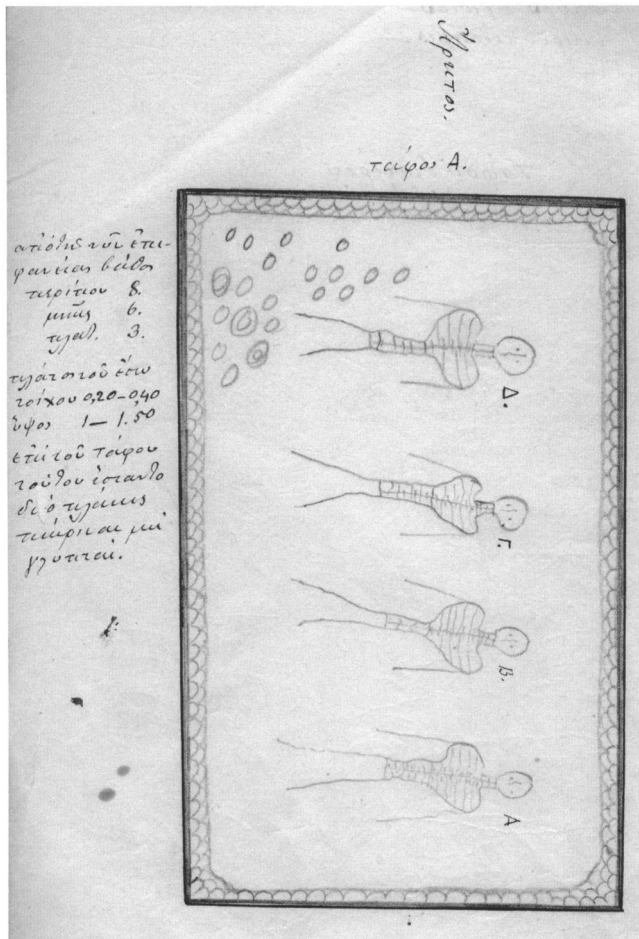
Schliemann recorded the number of the dead found in each of the five Shaft Graves, made comments on the condition of the bones, and published pictures of the best preserved of them. In his description he wrote of 'bodies' found and initially did not venture to identify the sex of the deceased with the exception of the three women buried in Grave III. Using the evidence of the grave furnishings he finally concluded that there were twelve men, three women, and two or three children (Dickinson 1977, 48). The number of the dead in Grave Circle A was established early on as seventeen adults and two children, including the individuals buried in Grave VI (Tsountas and Manatt 1897, 94), although the question of the sex of the individuals remained open. In more recent literature there are statements like 'eight men, nine women and two children' (Mylonas 1966, 164) but the accepted number now is nine men, eight women, and two children (Kilian-Dirlmeier 1986, 161–9, figs. 4–6; Demakopoulou 1990, 96–100).

Stamatakis numbered the Graves from I to V (using the Greek letters A to E), and this sequence prevailed in subsequent literature over Schliemann's numbering of the graves in *Mycenae* (Schliemann 1880). Stamatakis provided rough drawings of Graves I–V, adding in the margins information on the dimensions of the grave, the depth of the shaft from the present surface, and the number of the stelai found. North is indicated in writing (ἄρκτος). He used the Greek letters from A to Y to identify the bodies found in each grave and also counted the individuals in the burials found outside the graves. His reports on Graves I–V are for the most part detailed catalogues of the finds, which he numbered separately in each grave. A thorough attempt is made to attribute the grave furnishings to the persons buried, still an important desideratum in the study of the Shaft Graves. These numbers do not correspond with the inventory numbers of the Prehistoric Collection in the National Archaeological

Museum (NAM), followed by Karo (1930–3) and all other archaeologists since, and one must now depend on the description Stamatakis provides to identify each individual object. There are also a few remarks on the state of the preservation of the bones, while he refuses to comment on the sex of the deceased. However he clearly states that he collected the bones found in each grave in separate boxes, to be housed in the same cases as the other finds in the Polytechnion (Papazoglou-Manioudaki *et al.* 2009).

GRAVE I

In Schliemann's account this is the second grave (1880, 155). There are three people buried in it, whom he thought to be women. He notes that 'bones and skulls have been preserved but suffered so much from moisture that none of them could be taken out entire'. Stamatakis's drawing of Grave A (FIG. 1) and his description gives us four persons in the same grave (A, B, Γ, Δ). There is no information in the report on the condition of the bodies. Unfortunately the actual bones from Grave I are now not easy to identify nor is there relevant information in Angel's report on this grave.



GRAVE II

This is the fifth grave in Schliemann's numbering and contained only one person, according to Schliemann thought to be a man, whose 'skull was too fragile to be saved' (1880, 291). Stamatakis's drawing of Grave B (FIG. 2) again depicts two persons (E, Z). This time Stamatakis states that 'nothing is found alongside the second body': as the burial was unfurnished, we can assume that it did not attract much attention. He also mentions that two more bodies, presumably H and Θ, were found above Grave II, furnished with handmade vases. No drawing is provided for these burials and Grave II is also not included in Angel's report.

GRAVE III

At the end of Stamatakis's report on Grave II a separate page is dedicated to the two individuals found above Grave III, namely I and K. No drawing

FIG. 1. Drawing of Grave I from Stamatakis's report (A).

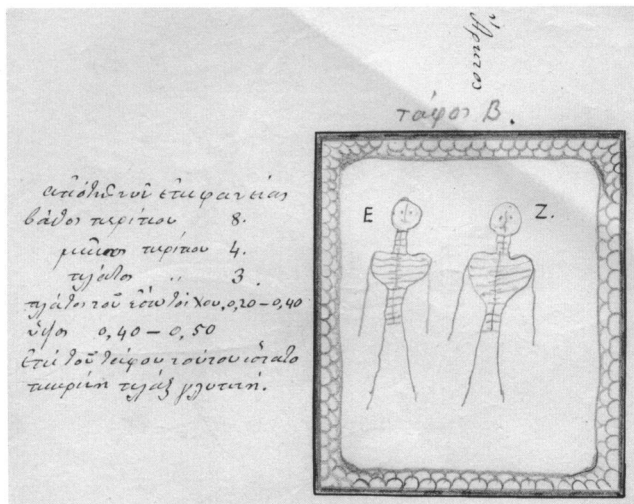


FIG. 2. Drawing of Grave II from Stamatakis's report (B).

is provided but he mentions some fragmentary bones and small handmade vases (NAM inv. nos. 157–60). These burials are also mentioned by Schliemann (1880, 162–3 figs. 136–7).

In the so-called women's tomb there is unanimity on the number of the persons buried. Schliemann clearly speaks of three women, indicated by 'the smallness of the bones and particularly of the teeth

and by the masses of female ornaments' (Schliemann 1880, 164). He specifies that one must be a very old lady because her teeth, though well preserved, were much worn. Stamatakis provides a drawing of three people (Λ, Μ, Ν) in Grave Γ (FIG. 3) and some information about the deceased. For individual Λ he states that only a few of the 'burnt' bones were preserved (Papazoglou-Manioudaki *et al.* 2009). A few of the finds are attributed to Λ, including the only gold cup in the grave (NAM inv. no. 73). Of the person buried in the centre, Μ, there are preserved 'the bones of the head, the torso and the legs although they are decayed and burnt' (on Schliemann's and Stamatakis's misunderstanding of the traces of decayed timber as 'burning', see Papazoglou-Manioudaki *et al.* 2009, 237). Μ is clearly an important figure to whom most of the grave furnishings are attributed, including the large gold diadem on the head (NAM inv. nos. 3, 5): as Stamatakis notes, when this was lifted part of the frontal bone of the skull was also removed. According to Stamatakis the other impressive diadem (NAM inv. no. 1) was found on the chest of burial Μ (cf. Schliemann 1880, 186–

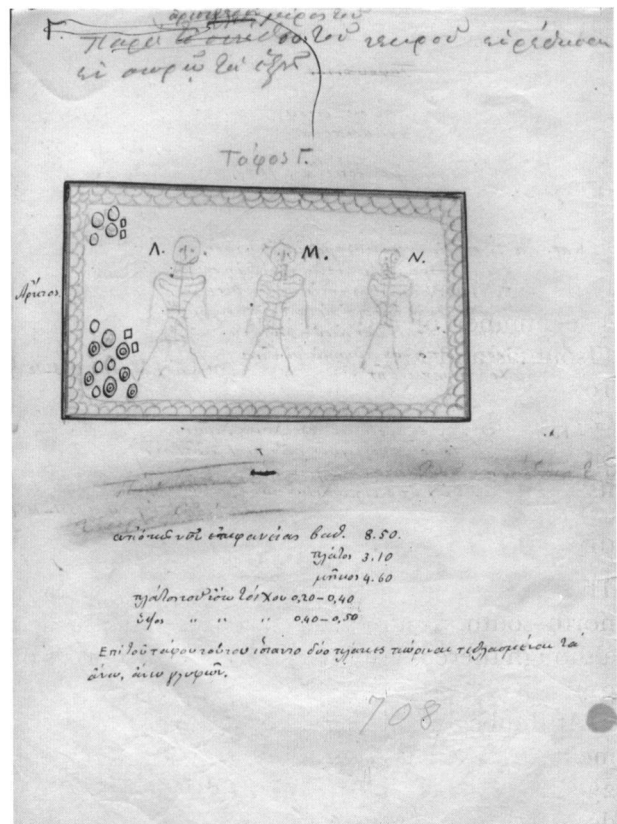


FIG. 3. Drawing of Grave III from Stamatakis's report (Γ).

7, figs. 281–2). The gold and silver pin with the fertility scene (NAM inv. no. 75) and the gold miniature toilet vases (NAM inv. nos. 72, 74, 83, 84, 85) are also attributed to this burial.

Stamatakis points out that the rest of the finds are found in the space between M and the burials A or N. The bronze vessels are all located on the northern side of the grave. He mentions specifically the existence of the four bronze casings full of decayed wood (NAM inv. nos. 147–50), two at the north-east corner and two at the north-west. They are presumably the four small rectangular shapes shown in the drawing (FIG. 3), which thus provides evidence that the casings were not in immediate association with the dead and attached to the legs of a wooden coffin, as has been suggested (Åkerström 1978, 38–42). The possibility that they formed part of a large chest cannot be ruled out (Long 1974, 17). Stamatakis concludes that ‘not a single sword was found in the grave and only one bronze knife’ (NAM inv. no. 154).

Schliemann (1880, 230 fig. 304) refers to one infant buried in the grave. Stamatakis assumes that it was buried on woman M’s chest, judging from the gold plates that cover its body (NAM inv. no. 146), but remarked that no trace of the infant’s bones was found there. The number of the gold plates presumably led Chr. Tsountas to speak of two children (Tsountas and Manatt 1897, 94) and this has passed as standard into the literature (Karo 1930–3, 62). However the study of the actual gold plates, as exhibited in the Mycenaean Gallery of the National Museum, indicates that we have only one infant, as Schliemann and Stamatakis have observed, literally covered with gold on the front (FIG. 4) and on the back of its body (FIG. 5).

GRAVE IV

There are five burials in Grave IV, three with a standard east–west orientation and two laid out north–south. Traditionally three of the burials are attributed to men and two to women, although there is also a reference to the burials of two men and three women (Mylonas 1966, 91).

At the beginning of his report Schliemann states that in the grave lay the ‘bodies of five men’ but in the course of his account he refers to them simply as ‘bodies’ (1880, 213, 219, 230, 284–5, figs. 338, 450). He says that ‘the skulls of the five bodies were in a state of decomposition’ but that he ‘collected all the bones that were not too much decayed and they

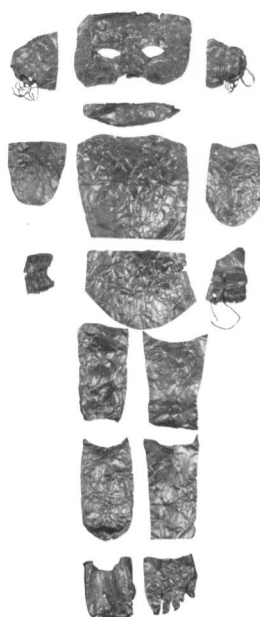


FIG. 4. Gold foil covering the infant, front (146).

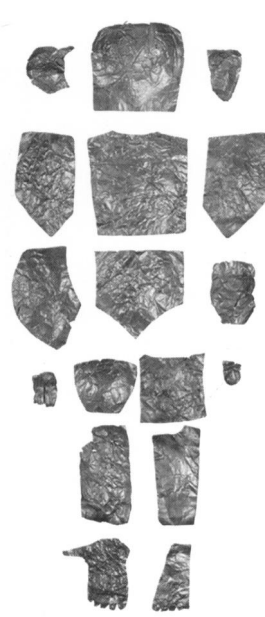


FIG. 5. Gold foil covering the infant, back (146).

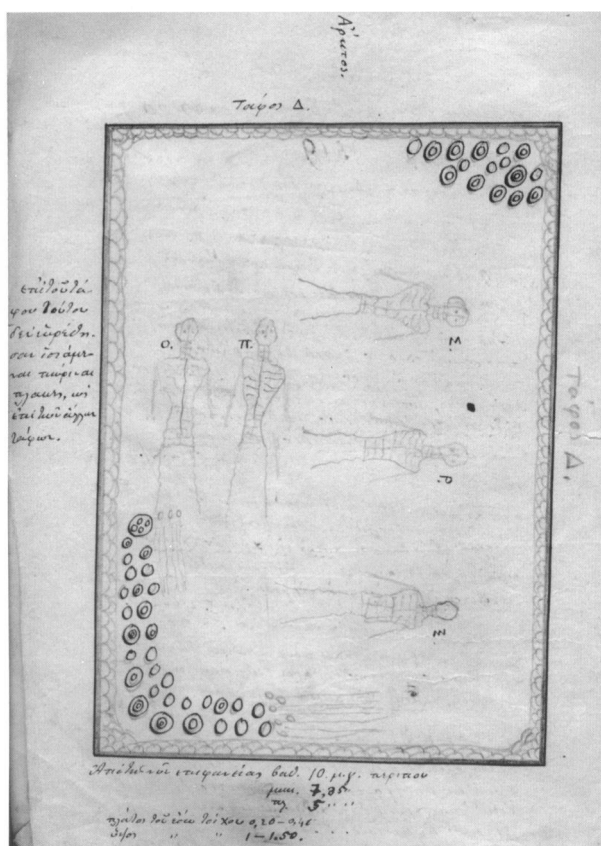


FIG. 6. Drawing of Grave IV from Stamatakis's report (Δ).

will be exhibited ... with the treasures' (NAM inv. nos. 618–22). He also provides figures of the best-preserved of them, a thigh bone with a gold knee band and a jaw.

Stamatakis provides a drawing of grave Δ (FIG. 6) with its five burials (Ξ, O, Π, P, Σ) and a catalogue of the finds. Burial Ξ is the one furnished with the silver bull's head rhyton (NAM inv. no. 384) and the gold lion's head rhyton (NAM inv. no. 273), which he describes more correctly than Schliemann as a gold lion mask (Dickinson 1977, 58). An arm bone was found wrapped in a gold band (NAM inv. no. 286). According to the report only a few broken bones are preserved from individual O, associated with the large silver crater (NAM inv. nos. 605–7), presumably the one later found to depict battle scenes (Sakellariou 1974). Inside the crater were deposited gold and silver vases including the so-called cup of Nestor (NAM inv. no. 412).

Burial Π is characterized as the best preserved. Thanks to Stamatakis's observations on the gold 'knee bands' we can associate the thigh bone mentioned by Schliemann with the individual Π. He was wearing a gold mask over his face (NAM inv. no. 259) and under it the bones of the skull and the jaw were shattered. A plain breastplate (NAM inv. no. 252) was found on his chest and he was furnished with bronze swords. There was also a gold mask on the face of the individual P, whose bones were found dispersed and poorly preserved. Stamatakis gives a similar description on the condition of the bones for the individual Σ, who also wore a gold mask.

In Stamatakis's report it is clear that three of the dead (Π, P, and Σ) were wearing gold masks. One, Π, has a north–south orientation, while P and Σ lie east–west. He comments, moreover, that the mask on Π was 'intact' and gives its dimensions as 27 × 28 cm. This corresponds well with the gold mask NAM inv. no. 259 (FIG. 7). The other two individuals, P and Σ, wore smaller 'much damaged masks' measuring 20 × 27–8 cm, which corresponds well to the almost identical gold masks NAM inv. nos. 253–4 (FIGS. 8–9). Schliemann gives a different account regarding the persons behind the masks, their place in the grave and their orientation (1880, 219–22, figs. 331–2), but it is safer to follow Stamatakis's notes in this respect.

The attribution of the furnishings to each of these individuals becomes problematic

because Stamatakis states that in between burials P and Σ were found important grave gifts such as the two gold signet rings (NAM inv. nos. 240–1, *CMS* i. 15–16), the silver stag (NAM inv. no. 388), and the heavy bracelet (NAM inv. no. 263). He mentions that the gold rosette on this bracelet, with which we are familiar from early on in the story of the excavation (Schliemann 1880, 227 fig. 339), although actually found in this context, was not attached to the central plate of the bracelet. In recent years the bracelet has been exhibited in the Mycenaean Gallery without the rosette, and a new interpretation has been put forward (to be published by Dr K. Demakopoulou). This rosette is now attached to the silver bull's head rhyton, which now quite properly features a double rosette on its forehead (Papazoglou-Manioudaki 2003, 119, 121).



FIG. 7. Gold mask, Grave IV (259).

GRAVE V

According to Schliemann this is the first grave (1880, 295–6, 301–2, 311–12, figs. 459, 474). It contained the bodies of three individuals, all traditionally considered to be male, who ‘lay with their heads to the east and their feet to the west’. He comments on the large proportions of the bodies, especially of the well-preserved legs. He mentions briefly the man on the south side, whose face was covered with a gold mask and whose skull ‘crumbled on being exposed to the air’. Two large leg bones are preserved and a smaller arm bone with a gold rosette band attached. He also gives a description of the two masks, especially the one with the long thin nose, the beard and the moustache. The body in the middle of the grave is poorly preserved and plundered.

In his drawing of Grave E (FIG. 10), Stamatakis gives three burials (T, Y, and Φ), two with an east–west and one with a north–south orientation. In this case he is more eloquent, speaking of ‘the most beautiful mask ever found which depicts a bearded man.’ This is the



FIG. 8. Gold mask, Grave IV (253).



FIG. 9. Gold mask, Grave IV (254).

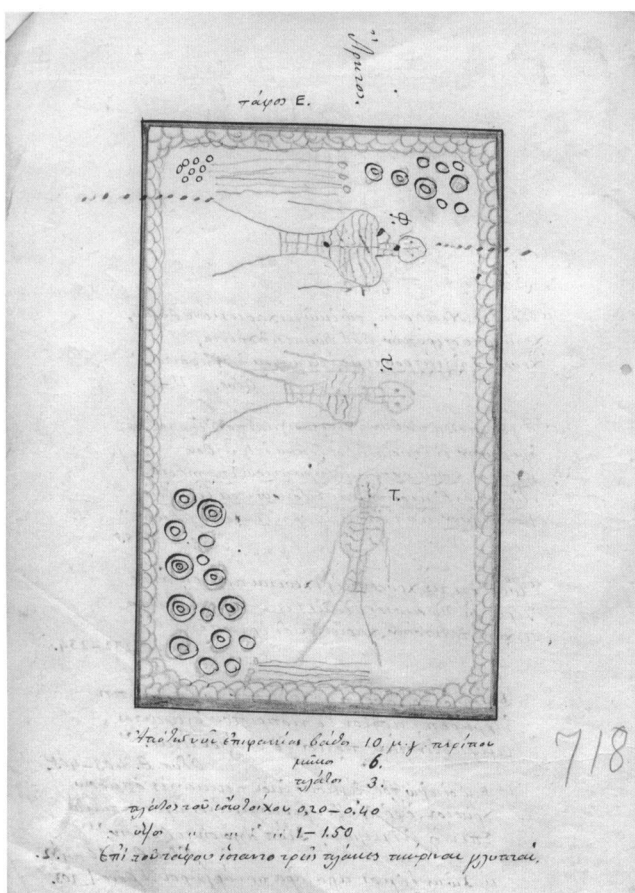


FIG. 10. Drawing of Grave V from Stamatakis's report (E).

according to him resembling the mighty 'Agamemnon' (Calder and Traill 1986, 234; Traill 1995, 163). It was so 'wonderfully preserved' that the body demanded special treatment, which he described in detail. Since then the mystery of the so-called mummy has haunted Bronze Age studies, so it is worth following its trail for a while. First it has to be noted that Schliemann only remarks that 'the color of the body resembled very much that of an Egyptian mummy' and speaks of a 'nearly mummified body' only after it was covered with alcohol and arsenic ('gum-sandarac') by the local pharmacist (Schliemann 1880, 296–8, figs. 454, 473; Prag and Neave 1997, 114–16). The remains were detached from the grave, along with soil on which they rested and brought to Charvati (Mycenae).

Stamatakis, on the other hand, does not get at all enthusiastic about individual Φ, the one at the north end, which is supposed to be the 'mummy'. In his usual restrained manner he refers to the east–west orientation of the body and proceeds to the description of the grave furnishings, the gold mask (NAM inv. no. 623) and the plain breastplate (NAM inv. no. 626) among them. There are no comments on the condition of the bones.

In his first small guide to the treasures of Mycenae as they were exhibited in the

clear though brief statement of an eyewitness who has been proved to be very thorough in his work. It is powerful enough to put an end to unjustifiable allegations about the authenticity of the golden masks, especially the one later dubbed 'Agamemnon's mask' (Prag and Neave 1997, 112–14; Dickinson 2005, 302–4).

The man with this gold mask (NAM inv. no. 624, FIG. 11) and the large ornate breastplate (NAM inv. no. 625) is individual T, placed on the south side but with a different orientation to that described by Schliemann. The impressive necklace with the eagles (NAM inv. no. 689) and gilded bronze weapons are associated with him. He mentions also the arm bone with a gold band (NAM inv. no. 649). Of the individual in the middle (Y) he only remarks that he had no gold mask or breastplate but that bronze vessels, large and small, were deposited nearby.

Schliemann's attention was really attracted to the third body, at the north end, its face covered also with a gold mask (FIG. 12), the one



FIG. 11. Gold mask, Grave V (624).



FIG. 12. Gold mask, Grave V (623).

Polytechnieon (Papazoglou-Manioudaki *et al.* 2009), Schliemann refers to the remains of the other burials of Grave V and 'the fractured skull' of the individual with the mask (NAM inv. no. 624) at the southern end of the grave. No special mention is made of the 'mummy' at this time (Schliemann 1882, 5, 7 Grave I). Nevertheless its remains were brought to Athens and featured as a permanent exhibit in the Mycenaean Gallery of the National Archaeological Museum before the Second World War. There are brief mentions in the guides to the Mycenaean Collection, always in association with Grave V, stating that the remains of a corpse 'sont exposés, enveloppés des plâtre tout autour, les restes d'un de trois corps ... dans le tombeau V' (Cavvadias 1894, 18). This was reproduced with additions or omissions as 'in the lower part of the case ... the rest of one of the three skeletons in this tomb which Schliemann assigned to Agamemnon!' (Stais 1909/1915, 62/70; 1926, 71) or 'on a plaster layer remains of a corpse', and after quoting Schliemann's writings this account concludes 'that is a proof that this body was embalmed but all this has now gone' (Philadelphus 1935, 62-3). The plaster is meant to support the soil beneath and around the 'mummy'. This practice of plaster casing is known to conservators and to my knowledge was used until recently to carry fragile finds to the Laboratory of the National Museum (Papazoglou-Manioudaki 1994, 173 n. 8).

From these accounts it is clear that the story of the 'mummy' has never been taken for granted and all early eyewitnesses speak of simple skeletal remains (Tsountas and Manatt 1897, 95-6).

The rediscovery of Schliemann's Albums in 1955 has provided us with the original oil painting of the 'mummy' (Hood 1960, 63-4; 1990, 113-21). The picture at last became clearer and more complete (FIG. 13), compared with the reproduction in Schliemann's *Mycenae* (1880, fig. 454), but that did not solve the mystery. An elliptical structure of earth, framed with plaster and measuring 1.30 × 0.70 m, on the surface of which amber beads could be discerned (FIG. 14), was identified as the plaster case of the 'mummy' in the storerooms of



FIG. 13. Oil painting of the 'mummy', Grave V.



FIG. 14. Plaster case of the 'mummy', Grave V.

the National Museum (Mylonas 1969, 141–2). Although Mylonas's theory about an Egyptian princess's marrying at Mycenae was not accepted (Dickinson 1977, 54) and his attribution of the finds may be revised in the light of the Stamatakis reports, it seems that he was right about the plaster case. The earth filling, when excavated, was found to contain amber beads and small fragments of gold and bronze foil, all compatible with the Shaft Grave material (Demakopoulou 2002, 3, fig. 2 *a–b*; Dickinson 2005, 303). Tiny fragments of bone were also discovered among these finds. It was obvious, however, that the body

that had rested on the structure had been removed somehow and at some time. Thus the need arose to identify anew the remains of the deceased buried at the northern end of Grave V among the skeletal material from the Shaft Graves that has survived through time in the National Museum.

3. THE HUMAN SKELETAL REMAINS (BY A. NAFPLIOTI AND J.H. MUSGRAVE)

INTRODUCTION

In 'Mycenae Revisited Part 1', we presented an analysis of the human skeletal material from Grave VI, and in 'Mycenae Revisited Part 2' explored the geographical origin(s) of the individuals buried in Grave Circle A (Papazoglou-Manioudaki *et al.* 2009; Nafplioti 2009). In this article we present the results of the first complete morphological analysis of the human skeletal material recovered from Shaft Graves III, IV, and V in GCA at Mycenae by Schliemann and Stamatakis at the end of the nineteenth century, which is now kept in the *apothēke* of the

Prehistoric Collection of the National Archaeological Museum in Athens. No material was available for examination from Graves I and II at the time of the present study.

Although the completeness of the GCA skeletons is poor, ranging from less than 10% to 60%, the dead were most probably interred as complete cadavers. Recovery practices of the late nineteenth century (Nafplioti 2007, 92), in combination with the problematic curation of the skeletal material during the lengthy period of unrest in Greece during the first half of the twentieth, most likely account for the incompleteness and mixing of the skeletons and the poor condition of the bones.

Six individuals from the GCA skeletal collection were studied in 1937 by Angel and a brief report (supplemented by cranial and post-cranial measurements and photographs) was incorporated into his study of the skeletal material from Grave Circle B at Mycenae (Angel 1973). This collection had also been sampled for DNA (Chilvers *et al.* 2008) and stable isotope analyses (Richards and Hedges 2007) before the ‘Mycenae Revisited’ project began.

AIMS

This study used morphological analysis of the human skeletal material recovered from the shaft graves in GCA in order to determine the number of individuals represented, their biological sex, and their age at death. We also tried to associate the individuals now represented as incomplete skeletons with the dead interred in the graves as described by Stamatakis in his excavation reports (Papazoglou-Manioudaki *et al.* 2009). Thanks to Stamatakis’s extremely thorough recording of the finds from the graves and his systematic cataloguing of the exhibits, it was possible to identify the ‘face’ behind the mask for at least some of the dead with varying degrees of confidence.

Further, this study endeavours to reconstruct the lifestyles of these individuals both through an assessment of the quality of their conditions of life as reflected in their skeletal and dental health and by exploring probable skeletal evidence of engagement in physical activities as shown by activity-related skeletal modifications. It will then use this evidence to discuss the biological connotations of the social status of these people as reflected at death through the evidence of material culture and to explore how effectively their higher social ranking could isolate them from the stresses of everyday life.

It should be noted that the information provided by the morphological analysis of the GCA remains is limited by their incompleteness and by the paucity of contextual information. Owing to the lack of excavation photographs or technical drawings of the interior of the shaft graves and of detailed recording of the skeletal material before its recovery and subsequent mingling, it has been almost impossible to discuss mortuary practices in GCA. In addition, because sample size is low and the GCA skeletons are far from complete, the cranial, dental, and post-cranial metric and non-metric data recorded could not be used with confidence to address issues of biological distance and biovariability at the intra- or inter-population level. Thus it was not possible to look for evidence of kinship through correlations between the grave-affiliation of the GCA individuals and occurrence of non-metric morphological traits. Nor could we use standard practices in biodistance studies to assess the biological distance (i.e. relatedness vs. divergence) between the GCA skeletal collection on the one hand, and other Aegean skeletal collections on the other (Larsen 1999).

MATERIALS

Overall, the completeness of the GCA skeletal material is poor, with the exception of individuals 1 and 2 in Graves IV (MYC₁, IV and MYC₂, IV), V (MYC₁, V and MYC₂, V) and VI (MYC₁, VI and MYC₂, VI). Although bone preservation is relatively good for the standards of Bronze Age skeletal material from Greece, trabecular bone is frequently damaged, the epiphyses of long bones are missing, and the shafts are fragmented. Hence the stature of only three individuals could be estimated.

Although at present the skeletal material from different graves in GCA is stored in separate boxes, the majority of the cranial material was found to be commingled. There is evidence too of the mixing of skeletal material between Graves III and IV, Graves IV and V, and between burials 1 and 2 of Grave VI. This will be discussed further in the 'Results' section. In order to separate the different burials and to reconstruct individuals from fragmentary cranial material, mandibles/mandibular fragments and/or post-cranial material, the authors used the photographs in Angel's report (Angel 1973), similarities of colour, texture and preservation of the bone fragments, skeletal robusticity, and/or the estimated age at death of the individuals.

The skeletons are represented principally by cranial material, predominantly fragments of the cranial vault. In order to avoid exaggerating the true number of individuals represented because of the post-excavation mixing of skeletal remains, the minimum number of individuals was not calculated separately for each grave. Instead, it was estimated for the GCA collection as a group, as fifteen adults, one sub-adult, and one infant. The latter was probably aged less than two years and is represented by post-cranial material only. The extra left zygomatic bone from Grave VI and the skeletal remains of individual A from Grave V (MYCA, V) are not included in this estimate: see the section on Grave V.

The minimum number of individuals in GCA calculated here (fifteen adults, one sub-adult, and one infant) is different from that reported by Schliemann (fifteen adults and two to three children) and Stamatakis (nineteen adults and one infant) set out in the account by Dr Papazoglou-Manioudaki above. Although Angel mentioned nine male and eight female adults as well as child(ren) from GCA he only gave data for six adults from Graves IV, V and VI, two from each grave (Angel 1973). Moreover, although he commented that a total of fifty-four people (both adults and sub-adults) from GCA and GCB were represented by twenty-nine skeletons or parts, he did not make clear in which cases the number and sex of the individuals reported reflected the osteological or other indirect evidence. See TABLE 1 for a juxtaposition of Nafplioti and Musgrave's, Stamatakis's, and Angel's skeleton referencing systems.

In this study the name of each individual comprises one arabic and one roman number; the first refers to the number of the skeleton and the second to the Grave from which he/she derives. For example MYC₁, III stands for individual 1 from Grave III. Very incomplete skeletons, i.e. the remains of the so-called mummy recovered from the plaster-framed earth structure, or the two incomplete long bones of an infant from Graves IV and V, were named using a letter of the Latin alphabet and a roman number; MYCA, V and MYCB, IV-V respectively, in order to distinguish them from the GCA individuals securely identified from cranial material. In addition, isolated cranial material that could not confidently be associated with any of the GCA individuals was also given a Latin letter and a roman number, e.g. Maxilla A, IV, or Maxilla B, IV; the letter refers to the specific specimen(s) and the number

TABLE 1. GCA skeleton referencing system according to Naflioti and Musgrave, Angel, and Stamatakis, and concise inventory for skeletal completeness, sex, age, and the principal pathological and non-pathological modifications recorded. Key: ✓ = Present; M = Male; F = Female; OA = Osteoarthritis

Grave	Skeleton name			Skeletal completeness			Sex	Age at death (years)	Pathologies				Non-pathological modifications
	Naflioti and Musgrave	Stamatakis	Angel	Cranial	Dental	Post-cranial			Dental		Skeletal		
									Caries	Hypoplasia	OA	Periostitis	
III	MYC ₁ , III	N		✓	✓	✓	M(?)	35-40					✓
	MYC ₂ , III	M		✓	✓	✓	F	30-35	✓				
	MYC ₃ , III	A		✓			M	<35					
IV	MYC ₁ , IV	Π	27 Myc.	✓	✓	✓	M	25-35 (~30)	✓				✓
	MYC ₂ , IV	Ξ	22 Myc.	✓	✓	✓	M	30-35			✓		✓
	MYC ₃ , IV	O		✓	✓	✓	M	17-20			✓		✓
	MYC ₄ , IV	Σ		✓			F(?)	20-25					
	MYC ₅ , IV			✓		✓	F(?)	25-35					
V	MYC ₁ , V	T	26 Myc.	✓	✓	✓	M	~25	✓			✓	✓
	MYC ₂ , V	Y	25 Myc.	✓	✓	✓	M	30-35					
	MYC ₃ , V			✓			M	>25					
	MYC ₄ , V			✓		✓	M	25-30			✓		✓
	MYC ₅ , V			✓			Unknown	young adult (?)					
	MYC ₆ , V	Φ		✓			Unknown	sub-adult					
	MYC _A , V			✓			F(?)	≤30					
	MYC _B , IV-V			✓	✓	✓		<2 (infant)					
VI	MYC ₁ , VI	Ψ	24 Myc.	✓	✓	✓	M	20-25					✓
	MYC ₂ , VI	X	23 Myc.	✓	✓	✓	M	25-35	✓	✓			✓

to the Grave. An exception was made for the extra mandible from Grave IV (Mandible 4, IV) to keep consistency with an earlier publication on this skeletal collection (Nafplioti 2009). In this case, number 4 refers to the fourth individual from Grave IV represented by a mandible; the other three are individuals MYC₁, IV, MYC₂, IV, and MYC₃, IV. Finally, we refer to the three separate groups of post-cranial material from Grave IV as post-cranial skeleton A, B, and C. The last are associated with individuals MYC₁, IV, MYC₂, IV, and MYC₃, IV respectively.

METHODS

Because of the poor preservation and incompleteness of the skeletal material examined, the age at death of each individual could not be established using information from the epiphyseal fusion of the long bones (Krogman and İscan 1986; McKern and Stewart 1957; Buikstra and Ubelaker 1994), morphological changes on the auricular surface (Lovejoy *et al.* 1985) or the pubic symphysis of the innominate bone (Brooks and Suchey 1990). These are the most widely used indicators of skeletal age at death (White and Folkens 2000, 349). The presence of fully developed third molars (wisdom teeth) was taken as evidence that an individual had reached adulthood by the time he/she died (Ubelaker 1989). A more precise age-estimate was obtained by analysis of dental attrition/tooth wear, which is suggested to be a reliable method of age determination for a variety of living and dead populations (Molnar 1971; Brothwell 1981; Mays 1998). Cranial suture closure was scored following Buikstra and Ubelaker (1994). Because the timing and degree of sutural closure is population-specific and possibly also sex-specific (Perizonius 1984; Ley *et al.* 1994), information derived from it was used in conjunction with age-estimates based on the assessment of dental attrition, where applicable. When no teeth were available, the degree of cranial suture closure was compared with that recorded on more complete skeletons for whom both dental and suture closure ageing was applicable.

Long bone length measurements were used to age isolated infant long bones (Scheuer and Black 2000).

Sex-determination derived from the assessment of the morphology of the innominate bone was only possible for individual A from Grave V (MYCA, V) and individual 1 from Grave VI (MYC₁, VI); instead, sex was determined mainly from certain aspects of cranial and mandibular morphology (Buikstra and Ubelaker 1994). A probable sex was assigned to post-cranial skeletons on the basis of their overall size and robusticity, according to the widely accepted notion that males are bigger and more robust than females of the same population (White and Folkens 2000, 362). Data on sex-determination for very incomplete skeletons should be treated with caution.

This study recorded both the metric and non-metric skeletal morphology of the GCA collection. Analysis of metric morphology aims to provide an accurate description of the size and shape of the skeletal elements analysed by means of a mutually consistent and coherent set of measurements. Non-metric traits, whose presence or absence is non-pathological, are features of the skeletal morphology difficult to score on an interval scale. The frequency of their occurrence within a population has been shown to convey information on its genetic constitution (Saunders 1989; Tyrell and Chamberlain 1998).

Cranial and post-cranial measurements were taken following the definitions of Howells (1973) and Buikstra and Ubelaker (1994) respectively. Bilateral cranial measurements were

taken from the left side for standardization. However, when the left measurement could not be taken, the right side was substituted. For bilateral post-cranial measurements, both right and left sides were recorded. Living stature was estimated from long bone length measurements using Trotter's formulae (Trotter 1970). Dental measurements were taken of the mesio-distal and bucco-lingual diameters of the crowns of both maxillary and mandibular teeth, as in Nafplioti (2007).

Following Hallgrímsson *et al.* (2004), all cranial and post-cranial non-metric traits were scored as dichotomous traits: present (1); absent (0); or unobservable (9). As in Nafplioti (2007, 100), non-metrics were scored as present if any degree of trait expression was observed. Right and left side traits were treated as separate variables and scored accordingly. Cranial and post-cranial non-metrics were scored using the respective definitions of Berry and Berry (1967), Ossenberg (1970), Czarnetzki (1971), Corrucini (1974), and Finnegan (1978). Definitions for the dental non-metrics employed in this study derive from Turner *et al.* (1991). However, the authors departed from the standardized Arizona State University Dental Anthropology System (ASUDAS) only insofar as gradations in the expression of dental non-metrics were not scored. For simplicity it was decided to score merely their presence or absence. For the equivalence between the scoring system employed in the present research and ASUDAS see Nafplioti (2007, 358).

The presence and severity of pathological modifications were recorded as in Buikstra and Ubelaker (1994). Also recorded were non-pathological skeletal modifications and in particular enthesopathies—the hypertrophic development of sites of muscle/tendon/ligament attachment on the skeleton—which in the literature are normally attributed to excessive mechanical loading of the respective muscle and skeletal elements in performing physical activities and are thus described as activity-related (Capasso *et al.* 1999). In some cases these lesions may be linked to disease (Rogers and Waldron 1995, 24). Severity of enthesophytosis may have an age component too, as the result of many years of wear and tear of tendons and ligaments (Mann and Murphy 1990, 91). In the present study these modifications were scored on a four-grade scale (0–3), where 0 stands for complete absence or insignificant changes while grades 1, 2, and 3 describe slight, moderate, and considerable modifications respectively. Where enthesopathies were observed, we describe the musculo-skeletal region involved and cite possible examples of physical activities which they may imply. However, our knowledge of the everyday life led by the people buried in GCA is still poor, and any inference about the specific physical activities involved based on these signs must be treated with caution.

RESULTS

The results of the morphological skeletal analysis are presented and discussed separately for each skeleton. The skeletons are grouped and named according to the Grave with which they are associated.

GRAVE III

Angel does not provide any description, measurements and/or photographs of the skeletal material from Grave III, mentioning only that it was a family grave of three females and child(ren) (Angel 1973, 391). At the start of this study, the skeletal material from this grave

was mainly commingled. Isolated cranial fragments were matched on bone colour, preservation, and robusticity to form individual crania.

Grave III, Individual 1 (MYC1, III)

This is probably individual N in Stamatakis's report. It is represented by skull fragments comprising 50% of the cranium and 10% of the mandible; nine teeth are present in the maxilla (80% complete) associated with the cranium. Post-depositional erosion of the ectocranial surface and dental enamel are moderate. The incomplete (15%) post-cranial skeleton (TABLE 2) from Grave III should probably be associated with this individual, on the grounds of similarity in colour and preservation. The bones are fragmented and very incomplete. Both the ectocranial and sub-periosteal bone surfaces have been weathered.

On the morphology of the supra-orbital ridges, glabella, and mastoid processes, MYC1, III is identified as a probable male. The post-cranial skeletal elements are less robust and shorter than those of the male skeletons from Graves IV and V. Stature could not be estimated owing to the absence of any intact long bones. The degree of cranial suture closure, where observable, suggests an age at death of 30 to 35 years for him. However, the ante-mortem loss of the maxillary right first and second molars and the severity of attrition for the other eight maxillary teeth, adds a decade to this age assessment: 35 to 45.

The left femur had been sampled before this study, and the maxillary left second premolar was sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ analysis as part of the 'Mycenae Revisited' project (Nafplioti 2009). Dental measurements and selected cranial, post-cranial, and dental non-metrics recorded for this individual are given in TABLES 3, 28, 29, and 30 respectively.

Dental chart of MYC1, III. The teeth are numbered according to the Fédération Dentaire Internationale protocol, which is explained in TABLE 32. They are charted in a notation devised by the authors. See TABLE 33 for a key to the symbols.

Upper Right								Upper Left							
				EH	EH		EH			EH	EH	EH			
[]	[]	[]	[]	✓	✓	✓	✓	✓	PM	✓	✓	✓	AM	AM	✓
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28

48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Lower Right								Lower Left							

Dental pathology. Hypoplastic lines were scored on the buccal surfaces of the crowns of six of the nine teeth present on the maxilla. They occurred close to the cemento-enamel junction on the maxillary right first incisor, right and left canines (three lines), right and left first premolars (three lines), and the left second premolar.

Post-depositional weathering of the enamel and dental attrition (grades 4 to 6 in Molnar's attrition scoring system) prevented a more comprehensive assessment of hypoplasia on this individual's teeth. Dental enamel hypoplastic lines reflect disturbances in enamel

TABLE 2. Individual MYC1, III: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	o					
Left scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	1	o%	o%	25%	9o%	1o%
Left radius	o	o%	o%	o%	o%	o%
Left ulna	1	95	1oo	8o	o%	o%
Left femur	3	75	<5	2o	75	o%
Left tibia	o	o%	o%	o%	o%	o%
Left fibula	o	o%	o%	o%	o%	o%
Left innominate	1o%, 1 fragment					
Left hand	Carpals Metacarpals Phalanges	o o o				
Left foot	Tarsals Metatarsals Phalanges	1 calcaneus (~1oo%), 1 talus (~1oo%) 1st (45%), 2nd (~1oo%), 3rd (~1oo%), 4th (~1oo%) o				
Left patella	1oo%, 1 fragment					
Right clavicle	o					
Right scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	1	o%	65%	1oo%	7o%	o%
Right radius	o	o%	o%	o%	o%	o%
Right ulna	o	o%	o%	o%	o%	o%
Right femur	o	o%	o%	o%	o%	o%
Right tibia	1	o%	o%	o%	3o%	9o%
Right fibula	o	o%	o%	o%	o%	o%
Right innominate	o					
Right hand	Carpals Metacarpals Phalanges	o o o				
Right foot	Tarsals Metatarsals Phalanges	o o o				
Right patella	1oo%, 1 fragment					
Sternum	o					
Vertebrae	Cervical		Thoracic		Lumbar	
	o		o		o	
Sacrum	o					
Left ribs	o					
Right ribs	o					

development: this process of amelogenesis begins at the occlusal surface of each crown, is directed towards the root, and ends at the cemento-enamel (crown-root) junction. Diet, disease, and other forms of stress may temporarily disturb ameloblastic activity during

TABLE 3. Individual MYC1, III: dental measurements (maxillary) (mm) (Nafplioti 2007), and other information.

Maxillary teeth L side	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
I 1st	7.50	8.60	4			
I 2nd						
C	7.95	7.60	4			
Pm3	9.65	7.95	5			
Pm4	8.95	6.40	6			
M1				35-45 years		Yes
M2						Yes
M3	11.60	10.65	2			
Maxillary teeth R side						
I 1st	7.50	8.85	4			
I 2nd	6.45	7.50	4			
C	8.95	7.70	4			
Pm3	9.50	7.00	4			
Pm4						
M1						
M2						
M3						

amelogenesis. Such disturbances manifest themselves as enamel hypoplastic defects on the tooth crown in various forms, most commonly as lines, pits, and grooves (Ortner 2003, 595). The actual position of the lines on the crown and data on dental development (Smith 1991) may be used to extrapolate the age at which the individual suffered this stress. Data on MYC1, III suggest that he probably experienced it at the age of 4 ± 1 years. This age would be compatible with late weaning, but hypoplastic lines need not exclusively be associated with the latter.

The loss of the maxillary left first and second molars not long before death is probably associated with the considerable resorption of the alveolar bone (FIG. 15). Well-recognized causes of alveolar resorption are severe dental attrition (Brothwell 1981, 154) and bacterially induced inflammation of the alveolar bone and adjacent tissues. A common irritant is dental calculus and its precursor, bacterial plaque, which consists of protein, food particles, and living and dead micro-organisms (Ortner and Putschar 1981, 442). As no calculus was present on MYC1, III's teeth, dental attrition may have accounted for both the alveolar resorption and the ante-mortem tooth loss.

Pathological and non-pathological modifications. The development of a medium-sized bony tubercle on the proximal shaft of the left ulna, antero-laterally and immediately inferior to the radial notch, probably suggests enthesophytosis of the supinator crest. This is the site where part of the supinator muscle arises from the ulna. According to Mann and Murphy (1990, 91) this probably reflects high mechanical stress on the arms and is a morphological feature commonly found in populations that use their arms in strenuous activities.



FIG. 15. Alveolar bone resorption on the maxilla of MYC1, III.

Moderate enthesophytosis of the linea aspera—in the form of irregular medium-sized enthesophytes on its medial border—is present on the posterior surface of the left femoral shaft. This is probably a non-pathological skeletal modification that may be associated with high mechanical loading of the muscles directly attached to the linea aspera during the performance of strenuous physical activities by the lower limbs (Capasso *et al.* 1999, 103–4). The linea aspera anchors vastus medialis, vastus lateralis, and adductors of the hip (adductors longus, brevis and magnus) (White and Folkens 2000, 236).

Evidence of ossification of the quadriceps tendon was observed on the anterior surface of each patella. On the superior and inferior portions of this tendon attachment site are medium-sized bony projections, a common finding in older people (Mann and Murphy 1990, 120). Moderate enthesophytosis of the Achilles tendon attachment site was scored on the left calcaneus (Mann and Murphy 1990, 120). No pathological changes were observed on the articular surfaces of either the

right and left patella or the left talus. Enthesophytosis on the above muscle attachment sites may reflect high mechanical stress operating on the lower limbs during physical activities repeated over this individual's lifetime.

Grave III, Individual 2 (MYC2, III)

This is probably individual M in Stamatakis's report. In pencil on the endocranial (internal) surface of the frontal bone is written '100'; in the catalogue to the report this number is assigned to furnishings associated with skeleton M. Stamatakis also noted that all the bones of its head and torso and the lower limbs had been preserved, and that they were 'burnt' and decayed. In agreement with Stamatakis's description, the cranial vault of MYC2, III is almost 50% complete, relatively well preserved, and dark green. The mandible is 30% complete and four of the five teeth associated with this individual are socketed in fragments of the maxilla and mandible. The loose tooth is a maxillary left canine. The greenish colour of the mandible, the maxilla, and the teeth (both roots and enamel) resembles that of the cranial vault. A few post-cranial elements were associated with them on grounds of colour, preservation, and robusticity. They include a right femur, a left tibia, and a right talus (see TABLE 4). They are darker in colour and look more like burnt bone than the post-cranial elements of MYC1, III, whose post-cranial skeleton, however, is more complete than MYC2, III's, although Stamatakis did not comment on post-cranial skeleton preservation in individual N.

On the morphology of certain features of the cranium—supra-orbital ridges, glabella, mastoid process, inclination of the forehead—this individual is identified as a definite female. The degree of closure of the coronal and sagittal sutures suggests an age at death of not less

TABLE 4. Individual MYC2, III: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	o					
Left scapula	1o%, 1 fragment					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	o	o%	o%	o%	o%	o%
Left radius	o	o%	o%	o%	o%	o%
Left ulna	o	o%	o%	o%	o%	o%
Left femur	o	o%	o%	o%	o%	o%
Left tibia	1	o%	9o%	4o%	o%	o%
Left fibula	o	o%	o%	o%	o%	o%
Left innominate	o					
Left hand	Carpals Metacarpals Phalanges	o o o				
Left foot	Tarsals Metatarsals Phalanges	o o o				
Left patella	o					
Right clavicle	o					
Right scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	o	o%	o%	o%	o%	o%
Right radius	o	o%	o%	o%	o%	o%
Right ulna	o	o%	o%	o%	o%	o%
Right femur	2	o%	4o%	1oo%	o%	o%
Right tibia	o	o%	o%	o%	o%	o%
Right fibula	o	o%	o%	o%	o%	o%
Right innominate	o					
Right hand	Carpals Metacarpals Phalanges	o o o				
Right foot	Tarsals Metatarsals Phalanges	1 talus (~1oo%) o o				
Right patella	o					
Sternum	o					
Vertebrae	Cervical		Thoracic		Lumbar	
	o		o		o	
Sacrum	o					
Left ribs	o					
Right ribs	o					

than 30 years. Her dental age, based on light attrition and the ante-mortem loss of the mandibular right second molar, is 25 to 35.

The left side of the mandible had been sampled before this study and the right mandibular

TABLE 5. Grave III: commingled post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments
Right clavicle	95%, 1 fragment
Right scapula	15%, 1 fragment
Sternum	30%, 1 fragment

TABLE 6. Individuals MYC2, III: cranial measurements (mm) (Howells 1973).

Measurement	Abbreviation	Value
Maximum cranial breadth	XCB	117.0
Bifrontal breadth	FMB	93.1
Nasion-bregma chord	FRC	111.3

first molar was sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ analysis (Nafplioti 2009). Cranial and dental measurements and selected cranial and dental non-metrics recorded for this individual are given in TABLES 6, 7, 28, 30, and 31 respectively.

Dental chart of MYC2, III

Upper Right								Upper Left							
										EH					
[]	[]	PM	PM	✓	PM	✓	PM	[]	[]	LT	[]	[]	[]	[]	[]
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
4 ⁸	47	4 ⁶	45	44	43	4 ²	4 ¹	3 ¹	3 ²	33	34	35	3 ⁶	37	38
PM	AM	✓	PM	PM	PM	✓	PM	[]	[]	[]	[]	[]	[]	[]	[]
Lower Right								Lower Left							

Dental pathology. Two hypoplastic lines on the maxillary left canine may indicate episodes of stress in this individual's early childhood (see MYC1, III for the causes of enamel hypoplasia). Moreover, as healing of the socket of the mandibular right second molar was in progress when she died, it can be inferred that this tooth was lost not very long before death.

Pathological and non-pathological skeletal modifications. The walls of this individual's cranium are relatively thick. The maximum thickness was 9.5 mm on the posterior portion of the right parietal. Thickening of the parietal walls results from the expansion of the diploë between the inner and outer tables of the cranial vault, a condition normally associated with thalassaemia, sickle-cell anaemia, and iron-deficiency anaemia (Ortner 2003, 89). Porotic hyperostosis of the ectocranial surface and cribra orbitalia, which normally accompanies hypertrophy of the diploë of the cranial vault in individuals who suffered from anaemias (Stuart-Macadam 1989), were not observed on this cranium. Although it is difficult to differentiate between the various types of anaemias that may cause hypertrophy of the diploë, in the present case either

TABLE 7. Individual MYC2, III: dental measurements (maxillary and mandibular) (mm) (Nafplioti 2007), and other information.

Maxillary teeth L side	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
I 1st						
I 2nd						
C	6.85	6.10	3			
Pm3						
Pm4						
M1						
M2						
M3						
Maxillary teeth R side						
I 1st					Yes	
I 2nd	6.00	5.60	3			
C					Yes	
Pm3	7.90	6.10	3			
Pm4					Yes	
M1					Yes	
M2						
M3						
Mandibular teeth L side						
I 1st						
I 2nd						
C						
Pm3						
Pm4						
M1						
M2						
M3						
Mandibular teeth R side						
I 1st					Yes	
I 2nd	5.40	5.00	3			
C					Yes	
Pm3					Yes	
Pm4					Yes	
M1	10.10	10.75	3			
M2				25–35 years		Yes
M3					Yes	

thalassaemia or iron-deficiency anaemia was probably responsible. Angel (1964, 1966) interpreted the presence of porotic hyperostosis in prehistoric crania from Greece as evidence of thalassaemia in antiquity. This interpretation is substantiated by the frequency of alpha and beta thalassaemia in the modern Greek indigenous population (Rucknagel 1966). If iron-deficiency anaemia was implicated, nutritional deficiencies, blood loss, parasitic infections, and/or chronic diarrhoea would have been part of this individual's life (Ubelaker 1992). This is in line with the dental evidence of episodes of stress in her early childhood mentioned above.

On the endocranial surface of the left side of the frontal bone, laterally to the frontal crest, one can palpate an area of thickened bone that may tentatively be interpreted as an early stage of hyperostosis frontalis interna (Waldron 2009, 78; Aufderheide and Rodríguez-Martín 1998, 419). See MYC₃, III for the aetiology of this condition.

No pathological modifications were recorded on either the left tibia or the right talus. No such observations could be made on the right femur because the sub-periosteal bone surface was severely weathered.

Grave III, Individual 3 (MYC₃, III)

This may be identified as individual A in Stamatakis's report and is represented by a less than 20% complete cranium, which is less well preserved than the cranial material from Graves IV, V, and VI. Post-depositional erosion of the ectocranial surface is moderate. An additional incomplete maxilla (10%) found in one of the boxes containing material from Grave IV may be assigned to MYC₃, III on grounds of similarities in colour and preservation. The right canine, first premolar, first, second, and third molars were lost post-mortem. The root of the right second premolar was present in the maxilla, its crown having been broken off post-mortem.

The morphology of the right supra-orbital ridge and the supra-orbital margin suggests this individual was male. Because there was no dental material that could be associated confidently with him, his age was determined by comparing the degree of closure of his coronal and lambdoid sutures with observations made on other individuals in this collection for whom data on dental attrition were also available. His age at death is estimated as less than 35 years.

Selected cranial non-metrics recorded for this individual are given in TABLE 28.

Pathological and non-pathological skeletal modifications. New bone formation was recorded on the endocranial surface of the frontal bone (FIG. 16). Irregularly shaped outgrowths of lamellar bone were deposited lateral to the frontal crest. They are less well-defined on the left than the right half of the frontal bone, where their size ranges from 3 mm × 3 mm to 4 mm × 7 mm. The aetiology of this condition, known as *hyperostosis frontalis interna*, is not well understood (Mann and Murphy 1990, 33, Waldron 2009, 78–9). Although it is assumed that it is caused by a pituitary disorder, its precise nature has not yet been defined. It is reported to be more common in older females (Aufderheide and Rodríguez-Martín 1998, 419).

Commingle and unassigned cranial, dental, and post-cranial material from Grave III

1. Eleven additional cranial fragments (TABLE 8). Two are part of an incomplete sphenoid of a sub-adult individual (Specimen 10, TABLE 8).
2. An unassigned mandible (85% complete). The right third molar was lost ante-mortem; the other 15 teeth post-mortem. The shape of its mental eminence suggests that it

probably belonged to a female. It could not be associated with the cranium of MYC3, III because of its greenish colour. It had also been sampled before this study.

3. A small fragment of a left maxilla with three teeth present in it: the upper left second incisor, canine, and first premolar. The incisor was fractured post-mortem and intermittent calculus is present on the canine and first premolar. The size of the teeth and the degree of dental wear suggest a probable female individual who had not reached an advanced age by the time of her death.
4. Eleven loose teeth are reported from Grave III. Intermittent calculus was recorded on the crown of five of them. On three it is considerable; on two it is medium; and on one it is slight. A mandibular left second molar was the only tooth to have a carious lesion. It extended from the interproximal surface mesially to the occlusal surface of the mesio-buccal cusp. Three teeth were fractured. On one of them, a right mandibular third molar, the mesial interproximal surface had been fractured. This probably occurred before death because its edges were worn smooth. The damaged edges on the other two are sharp, which suggests that they were fractured after death. In modern populations, dental fractures are commonly caused by automobile accidents or injuries during participation in sports or fights, and are more frequent in males than females. Among the individuals from Grave Circle A, we might expect dental fractures to have occurred as a result of their occupation-related and other physical activities, and/or their diet.
5. An incomplete sternum (the manubrium is present, while the *corpus sterni* and the xiphoid process are missing), a right scapula, and a fairly complete right clavicle (TABLE 5). Moderate enthesophytosis was observed on the attachment sites for the conoid ligament and the deltoid muscle on the lateral half of the right clavicle. Slight enthesophytosis of the pectoralis muscle attachment site is indicated by roughening of this site and the squaring-off of the clavicular shaft antero-medially. These skeletal modifications probably reflect high mechanical loading of the pectoral girdle in the performance of physical activities (Capasso *et al.* 1999, 39).
6. One animal bone fragment was found mixed with the human skeletal material from this grave: a scapula of an animal of the size of a sheep or goat.



FIG. 16. Hyperostosis frontalis interna on the endocranial surface of the frontal bone of MYC3, III.

GRAVE IV

In his report, Angel (1973) gave cranial measurements and brief information for two individuals only from Grave IV, individuals 22 Myc. and 27 Myc. However, the minimum number of individuals represented by the human skeletal material from Grave IV was calculated as five on the cranial material recorded. Three separate groups of post-cranial

TABLE 8. Grave III: commingled cranial material.

Specimen	Frontal	Parietal			Temporal			Occipital	Sphenoid	Maxilla		
		Left	Right	Unsidcd	Left	Right	Unsidcd			Left	Right	Unsidcd
1		5%						15%				
2			<5%									
3		<5%										
4												
5						<5%						
6								25%				
7						15%						
8							<5%					
9	<5%											
10	<5%											
(2 fragments)									<10%			

TABLE 9. Individual MYC1, IV: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	95%, 1 fragment					
Left scapula	60%, 1 fragment					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	1	0%	0%	0%	85%	0%
Left radius	2	100%	100%	100%	100%	100%
Left ulna	2	50%	90%	100%	90%	0%
Left femur	1	98%	100%	100%	100%	90%
Left tibia	1	0%	0%	50%	85%	0%
Left fibula	0	0%	0%	0%	0%	0%
Left innominate	0					
Left hand	Carpals Metacarpals Phalanges	0 0 1 proximal (100%)				
Left foot	Tarsals Metatarsals Phalanges	0 0 0				
Left patella	95%, 1 fragment					
Right clavicle	0					
Right scapula	0					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	2	5%	100%	100%	95%	5%
Right radius	1	5%	100%	100%	100%	100%
Right ulna	0	0%	0%	0%	0%	0%
Right femur	1	95%	100%	100%	95%	0%
Right tibia	2	0%	95%	100%	100%	25%
Right fibula	0	0%	0%	0%	0%	0%
Right innominate	0					
Right hand	Carpals Metacarpals Phalanges	0 0 0				
Right foot	Tarsals Metatarsals Phalanges	1 talus (~100%), 1 intermediate cuneiform (~10%), 1 medial cuneiform (~10%) 2nd (~100%) 0				
Right patella	95%, 1 fragment					
Sternum	0					
Vertebrae	Cervical		Thoracic		Lumbar	
	0		0		0	
Sacrum	0					
Left ribs	0					
Right ribs	0					

elements were found in a box labeled 'Grave IV' and at least five additional bones from this grave were once exhibited in the Museum together with the associated gold jewellery. Based on macroscopically observed similarities in the colour, preservation, and robusticity of the

bones these three incomplete post-cranial skeletons were associated with cranial material from this grave in an attempt to reconstruct skeletons.

Grave IV, Individual 1 (MYC1, IV)

This is individual 27 Myc. in Angel's report (Angel 1973, 384) and individual II according to Stamatakis. On the endocranial surface of the frontal bone is written in pencil '1567'; in Stamatakis's report this number is associated with the furnishings of individual II. In line with his and Schliemann's descriptions (1880, 284-5), the mandible associated with this cranium is at present 90% complete, despite being sampled before this study. Moreover the femora of MYC1, IV can confidently be identified with the right and left femora of II on the photograph of the left femur in Schliemann (1880, 230), the length measurement (0.47 m) given for this specimen by Stamatakis, and other relevant information in his report. As Stamatakis observed, individual II or MYC1, IV is the best preserved skeleton in this grave.

Angel reconstructed the cranium from fragments; it is 50% complete. The morphology of the nuchal crest and mastoid processes suggests this was a male individual. This is confirmed by the protrusion of the mental eminence on the mandible. Analysis of the dental wear and

TABLE 10. Individual MYC1, IV: cranial measurements (mm) (Howells 1973).

Measurement	Abbreviation	Value
Nasion-bregma chord	FRC	104.6

TABLE 11. Individual MYC1, IV: dental measurements (maxillary and mandibular), (mm) (Nafplioti 2007), and other information.

Maxillary teeth L side	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
I 1st						
I 2nd						
C						
Pm3						
Pm4						
M1						
M2						
M3						
Maxillary teeth R side						
I 1st					Yes	
I 2nd					Yes	
C					Yes	
Pm3	9.13	6.87				
Pm4		6.73				
M1					Yes	
M2						
M3						

Mandibular teeth					
L side					
I 1st					Yes
I 2nd	6.30	5.00	3		
C	8.20	6.50	3		
Pm3	8.25	6.75	3		
Pm4	8.25	7.10	3		
M1	10.25	10.75	4	25–35 years	
M2	10.25		4		
M3					Yes
Mandibular teeth					
R side					
I 1st					Yes
I 2nd					Yes
C	7.95	6.30	3		
Pm3	8.00	6.70	3		
Pm4	8.50	7.00	3		
M1	10.25	11.00	4	25–35 years	
M2	10.35	10.40	3		
M3	10.00	10.55	3		

TABLE 12. Individual MYC1, IV: post-cranial measurements (mm) (Buikstra and Ubelaker 1994).

Skeletal element	Side	Measurement	Value
Clavicle	Left	Maximum length	156.0
Radius	Left	Maximum length	247.0
Femur	Left	Maximum length	458.0
Femur	Left	Maximum diameter of head (damaged)	43.5
Femur	Right	Maximum diameter of head (damaged)	42.7

the ante-mortem loss of the mandibular left third molar suggest that he died at the age of 25 to 35, and most probably around 30 years. The degree of cranial suture closure, where observable, points to a younger age of around 25 years. However, as there is no evidence that the cranium and mandible associated with individual 27 Myc. represent two different individuals from Grave IV, one can give greater credence to the dental ageing for reasons outlined in the 'Methods' section. Similarities of colour and preservation of the bone, the estimated age at death and skeletal robusticity and also the archaeological information available all suggest that the post-cranial skeleton A (TABLE 9) from Grave IV is associated with the skull of 27 Myc. However, Angel does not provide any description or measurements for any of the post-cranial material from Grave IV. Post-cranial skeleton A is 50% complete and mainly comprises long bones or shaft fragments. Only seven small bones are present: a right and a left patella, a left hand phalanx, a right second metatarsal, a right talus, and the incomplete right intermediate and medial cuneiforms. The latter are fused to the articulating right second metatarsal. The stature of this individual was calculated as 1.70 m and 1.72 m on the length of the left femur and the left radius respectively.

The right tibia was sampled before this study and the mandibular right first molar was sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ analysis (Nafplioti 2009). Cranial, dental, and post-cranial measurements and selected cranial, post-cranial and dental non-metrics recorded for this individual are given in TABLES 10, 11, 12, 28, 29, 30, and 31 respectively.

Dental chart of MYC1, IV

Upper Right								Upper Left							
[]	[]	PM	✓	✓	PM	PM	PM	[]	[]	[]	[]	[]	[]	[]	[]
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28

48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
✓	✓	✓	✓	✓	✓	PM	PM	PM	✓	✓	✓	✓	✓	✓	AM
CB				EH	EH					EH	EH			CIP CO	

Lower Right								Lower Left							
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Dental pathology and other non-pathological observations. Two of the twelve mandibular teeth recorded have carious lesions. One is located on the buccal surface of the disto-buccal cusp of the mandibular right third molar, immediately superior to the cemento-enamel junction. The other two occur on the left second molar; on the distal inter-proximal surface and on the occlusal surface of the crown.

In addition, this individual shows considerable resorption of the alveolar bone (FIG. 17). This probably arose from periodontitis, which is the inflammatory response of the alveolar bone and adjacent tissues to one or more irritants. For the role of calculus as an irritant see on MYC1, III above. Slight to medium intermittent calculus was recorded on eight of the twelve mandibular teeth and the two maxillary teeth recorded. It is slight on the mandibular left second molar, right canine, right first premolar, right second premolar, right first molar, and the maxillary first and second premolars, and medium on the left second premolar, left first molar, and the left second (lateral) incisor.

Additional evidence that alveolar resorption was caused by periodontitis is provided by the presence of prolific exostoses on the anterior most superior border of the horizontal mandibular ramus, immediately inferior to the left first (central) and second (lateral) incisors. Exostoses develop as a



FIG. 17. Alveolar bone resorption on mandible of MYC1, IV.

response to inflammation of the alveolar bone and/or adjacent tissues. Post-depositional damage to the superior border of the right ramus did not allow recording of new bone formation there.

Hypoplasia was recorded on the right and left mandibular canines and first premolars of this individual. Three hypoplastic lines were scored on the canines and two less distinct ones on the first premolars. The latest line occurs immediately superior to the cemento-enamel junction, the earliest below the middle of the tooth crown.

The position of these hypoplastic lines on these particular teeth suggests that this individual experienced some stress around the third year of his life. For more information on enamel hypoplasia see the relevant section on MYC 1, III. Finally, a portion of enamel from the buccal surface of the mandibular left second molar has flaked off. The nature of the fractured edges of this tooth suggests that the fracture occurred post-mortem.

Pathological and non-pathological skeletal modifications. Small pits with regular walls were recorded on the endocranial surface of the frontal bone. They cover an area of 7.5 mm × 5.5 mm on the right portion of this bone and are identified as Pacchionian or arachnoid granulation pits, a common finding (Mann and Murphy 1990, 34). These pits are formed by erosion of the inner table of the cranial vault as a result of the enlargement and ossification of the arachnoid granulations that filter cerebrospinal fluid. Enlargement of arachnoid granulations comes with ageing (Buikstra and Ubelaker 1994, 108), but the depth and frequency of these lesions may possibly increase with disease too (Mann and Murphy 1990, 34).

Enthesophytosis recorded on muscle attachment sites on the right and left radii and the left ulna may reflect high mechanical stress on the arms of this individual. Moderate hypertrophic development of the dorsal tubercle is present on the posterior surface of the distal shaft of the right and left radii of this individual. The grooves that form on this portion of the bone between the dorsal tubercle and others accommodate the tendons for the extrinsic extensor muscles of the hand (White and Folkens 2000, 191). There is also slight roughening of the sub-periosteal bone on the lateral surface of the midshaft of the right radius. This is the site of insertion of pronator teres (Mann and Murphy 1990, 91) and the area affected measures 24 mm × 8 mm. These changes were probably mechanically induced.

There is a medium-sized bony tubercle on the interosseous crest immediately distal to the radial notch on the proximal shaft of the left ulna that resembles enthesophytosis of the supinator crest and may also be activity-related. This is where part of the supinator muscle arises from the ulna. According to Mann and Murphy (1990, 91) this is a morphological feature commonly found in populations that use their arms in strenuous activities.

Portions of two right tarsal bones—the intermediate and medial cuneiforms—had broken off and are preserved ankylosed—fused—to the proximal articular end of the right second metatarsal (FIG. 18). Moreover, there is no dorsal

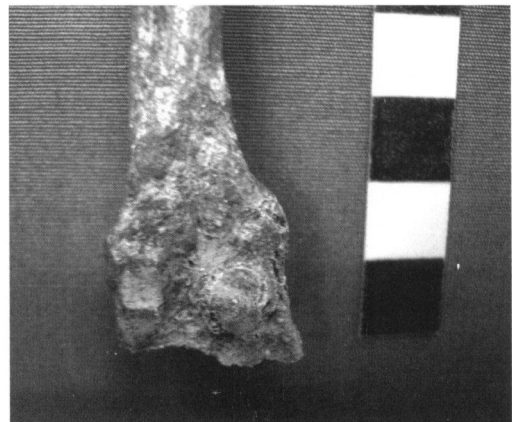


FIG. 18. Proximal end of right second metatarsal of MYC1, IV, showing fusion to articulating tarsal bones.

TABLE 13. Individual MYC2, IV: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	o					
Left scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	1	o%	95%	1oo%	1oo%	8o%
Left radius	1	1oo%	1oo%	4o%	o%	o%
Left ulna	o	o%	o%	o%	o%	o%
Left femur	1	o%	75%	1oo%	9o%	5o%
Left tibia	1	o%	o%	15%	8o%	o%
Left fibula	o	o%	o%	o%	o%	o%
Left innominate	o					
Left hand	Carpals Metacarpals Phalanges	o o o				
Left foot	Tarsals Metatarsals Phalanges	Calcaneus (85%), talus (95%) o o				
Left patella	o					
Right clavicle	95%, 1 fragment					
Right scapula	7o%, 1 fragment					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	1	o%	75%	1oo%	95%	75%
Right radius	1	5%	9o%	9o%	1oo%	1oo%
Right ulna	1	4o%	9o%	5o%	o%	o%
Right femur	2	8o%	7o%	1oo%	95%	o%
Right tibia	2	o%	6o%	1o%	3o%	9o%
Right fibula	o	o%	o%	o%	o%	o%
Right innominate	o					
Right hand	Carpals Metacarpals Phalanges	o o o				
Right foot	Tarsals Metatarsals Phalanges	o o o				
Right patella	1oo%, 1 fragment					
Sternum	o					
Vertebrae	Cervical		Thoracic		Lumbar	
	o		o		o	
Sacrum	o					
Left ribs	o					
Right ribs	o					

articular facet on the lateral side of the proximal end of the metatarsal, which instead lies on the articulating portion of the intermediate cuneiform. An accurate assessment of this lesion could not be made because the other bones of this foot were missing. Ankylosis of a joint may

result from many conditions, among them disease, developmental or congenital defects, endocrinological disturbances, and trauma. Because similar modifications are absent from

TABLE 14. Individual MYC2, IV: cranial measurements (mm) (Howells 1973).

Measurement	Abbreviation	Value
Maximum frontal breadth	XFB	111.5
Bifrontal breadth	FMB	98?
Nasion–bregma chord	FRC	114?

TABLE 15. Individual MYC2, IV: dental measurements (maxillary and mandibular) (mm) (Nafplioti 2007), and other information.

Maxillary teeth	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
L side						
I 1st					Yes	
I 2nd					Yes	
C					Yes	
Pm3						
Pm4						
M1						
M2						
M3						
Maxillary teeth						
R side						
I 1st					Yes	
I 2nd					Yes	
C					Yes	
Pm3					Yes	
Pm4		7.55	4			
M1					Yes	
M2					Yes	
M3						
Mandibular teeth						
L side						
I 1st		5.50	5			
I 2nd						
C						
Pm3						
Pm4						
M1						
M2						
M3						

Mandibular teeth**R side**

I 1st					
I 2nd		6.55	4		
C		7.45	3		
Pm3		7.15	3		
Pm4		7.40	3		
M1					
M2	10	11.25	4	25-35 years	
M3					Yes

TABLE 16. Individual MYC2, IV: post-cranial measurement (mm)
(Buikstra and Ubelaker 1994).

Skeletal element	Side	Measurement	Value
Clavicle	Right	Maximum length	152.0

the other preserved joints of MYC1, IV, this lesion may be either the result of trauma (Aufderheide and Rodríguez-Martín 1998, 105) or congenital.

No pathological modifications were observed on any of the other articular surfaces.

Grave IV, Individual 2 (MYC2, IV)

This is individual 22 Myc. in Angel (1973, 384) and probably individual Ξ in Stamatakis's reports. As with 27 Myc., Angel did not comment on the post-cranial skeleton associated with this skull. The similarity between the completeness, preservation, and estimated age at death of the possessors of this skull and the post-cranial skeleton B (TABLE 13) from Grave IV indicates that the two assemblages are probably associated and represent individual MYC2, IV. Maxilla no. 3, which was kept with material from Grave III and could not be associated with any of the crania from that grave on grounds of colour and preservation, was assigned to MYC2, IV. Although there were no markings on any of the bones of MYC2, IV that could help with their identification, their completeness and good preservation could not be matched with any of the other poorly preserved individuals in this grave, as described by Stamatakis.

The cranial fragments were glued back together by Angel and comprise 50% of the complete cranium. The mandible is 50% complete; its left half is almost entirely missing. The post-cranial skeleton is 40% complete and mainly comprises long bone shafts or shaft fragments with damaged articular ends. Certain morphological features of the cranium and the mental eminence on the mandible appear to be male. Even though the innominate bones and sacrum are absent, the rest of the post-cranial skeleton is also male on grounds of robusticity. The severity of dental enamel attrition suggests that he was 25 to 35 years old at death. The state of closure of his cranial sutures suggested a similar estimate of 30 to 35 years.

The mandible, left femur, and right tibia had been sampled before this study. The mandibular right first premolar was sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ analysis (Nafplioti 2009). Cranial, dental, and post-cranial measurements, plus selected cranial, post-cranial, and dental non-metrics recorded for MYC2, IV are given in TABLES 14, 15, 16, 28, 29, 30, and 31 respectively.

Dental chart of MYC2, IV

Upper Right								Upper Left							
[]	PM	PM	✓	PM	PM	PM	PM	PM	PM	PM	[]	[]	[]	[]	[]
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
PM	✓	S	✓	✓	✓	✓	[]	✓	[]	[]	[]	[]	[]	[]	[]
	CB	C A													
Lower Right								Lower Left							

Dental pathology and non-pathological observations. Out of the eight teeth present, the right mandibular first and second molars had carious lesions. That on the second molar is small and occurs on the buccal surface of the crown. By contrast, the carious lesion on the first molar is severe and resulted in the complete destruction of the crown and part of the roots. Only the mesial root is present in its socket. The distal root was lost post-mortem. This lesion would have caused much pain as the pulp cavity was exposed, resulting in infection, abscess formation, and destruction of the periodontium (Ortner and Putschar 1981, 439; see FIG. 19). Despite post-depositional damage to this area of the mandible, there are signs of an abscess on the mandibular body, inferior to the right first molar. A small area of new lamellar bone immediately inferior to the abscess may be interpreted as an inflammatory response of the periosteum to infection.

Intermittent calculus was recorded on the crowns of all eight teeth, its severity ranging from slight to considerable. Owing probably to the presence of calculus and the abscess described above, the alveolar bone was slightly resorbed (Ortner and Putschar 1981, 442). Enamel fracture on the mandibular right second molar probably occurred post-mortem.

Pathological and non-pathological skeletal modifications. As with MYC1, IV, small arachnoid granulation pits were observed on the endocranial surface of the left parietal close to the bregma anteriorly, but principally on the frontal bone. The largest pit measured 6.0 mm × 6.3 mm.

This individual shows the most



FIG. 19. Abscess on the mandibular body (inferior to right first molar) of MYC2, IV.

severe enthesophytosis on muscle attachment sites of the post-cranial skeleton recorded in the GCA collection, the skeletal modifications being observed on all the post-cranial elements present. On the upper limbs considerable roughening of the deltoid tuberosity was recorded on both the right and left humeral shafts (FIG. 20). New bone formation has taken the form of prolific and irregular bony outgrowths (enthesophytes) on the site where deltoid inserts on to the humeral shaft. This muscle is a major abductor of the arm (White and Folkens 2000, 184). Analogous modifications were recorded on the right clavicle at the site of the origin of deltoid on the lateral end of the clavicle, where it is roughened by enthesophytes. There is also considerable roughening of the crests of the greater and lesser tubercles on each humerus. Attached to them are muscles that flex, weakly adduct, abduct, and medially and laterally rotate the arm (White and Folkens 2000, 183). These enthesophytes are similar in form to those on the deltoid tuberosity and are thicker on the right humerus than the left. Finally, small enthesophytes are present on the superior surface of the medial epicondyle of the right humerus. This is the site of attachment of the pronator teres, the ulnar collateral ligament, and many of the flexor muscles of the forearm and hand (White and Folkens 2000, 185; Mann and Murphy 1990, 87).

The right ulnar tuberosity, where the brachialis—a flexor of the elbow—attaches to the ulna, shows moderate hypertrophy. The interosseous crest on the right radius was considerably thickened; the corresponding area on the left less so. Attached along these crests on opposing surfaces of the radius and ulna is the interosseous membrane, which divides the forearm into anterior and posterior compartments for the muscles acting across the wrist (White and Folkens 2000, 188). Enthesophytosis was also observed on the posterior midshaft of each radius at the site of the insertion of the pronator teres, considerable on the right and moderate on the left. There is also moderate hypertrophy of the dorsal tubercle on the right distal radius, and the ulnar tuberosity and supinator crest on the lateral surface of the right ulna (see relevant section on MYC1, IV). Bilateral occurrence of enthesophytosis on these three sites could not be scored as the left radial shaft and ulna were not present.

Finally, on the right clavicle, moderate enthesophytosis was recorded on the site of attachment of pectoralis major and the conoid ligament, which help to reinforce its articulation with the scapula (White and Folkens 2000, 168).

Severe hypertrophy of the gluteal line and linea aspera was observed on the posterior surface of the right and left femoral shafts. Roughening of the sub-periosteal bone surface on these sites results from the development of prolific enthesophytes mainly on the borders of



FIG. 20. Enthesophytosis on the deltoid tuberosity of the right and left humeri of MYC2, IV.

the linea aspera and on the gluteal line. The gluteal line is the site of insertion of part of the gluteus maximus muscle that originates on the posterior half of the innominate bone, sacrum, and coccyx and serves as an extensor and lateral rotator of the femur at the hip (White and Folkens 2000, 235). Enthesophytes are larger on the left side.

Considerable enthesophytosis was also recorded on muscle attachment sites on the right tibia, in particular the popliteal line and the tibial tuberosity. The popliteal line anchors the popliteus fascia and soleus muscle, which is a plantar flexor of the foot at the ankle. It also provides attachment to the popliteus muscle that originates from the lateral femoral condyle and serves as a flexor and medial rotator of the tibia (White and Folkens 2000, 243). The most important function of the popliteus is to unlock the knee by laterally rotating the femur on the tibia. The tibial tuberosity is the site of insertion of the patellar ligament of the quadriceps femoris muscle, which is a major extensor of the leg at the knee (White and Folkens 2000, 245).

The bony projections on the latter measure 21.0 mm (height) $\times$ 21.0 mm (breadth) $\times$ 7.5 mm (thickness) (FIG. 21) and indicate ossification of part of the patellar ligament that attaches there, probably resulting from trauma (Resnick 2002, 358–9; Mann and Hunt 2005, 194). Analogous are the skeletal modifications on the right patella: thick bony projections attached to and flowing across the anterior surface of this bone that result from the ossification of the tendon of quadriceps femoris (Mann and Murphy 1990, 120). In addition slight lipping marginal to the articular surface was recorded on more than half of the rim of the latter.

Finally, considerable enthesophytosis was recorded on the site of attachment of the Achilles tendon and the postero-inferior portion of the left calcaneus (FIG. 22). Thick bony projections (superior and inferior) at this site are normally associated with repeated or acute trauma to the Achilles tendon, and the abductor hallucis and flexor digitorum brevis tendons (Mann and Murphy 1990, 129; Mann and Hunt 2005, 206).

The skeletal modifications described above are generally thought to be activity-related and to reflect high mechanical loading of the muscles, ligaments, and skeletal elements to which the former attach while performing physical activities. Mann and Murphy (1990, 112) suggest that the occurrence of some of the above lesions is a common finding in individuals of advanced age and/or suffering from DISH (Diffuse Idiopathic Skeletal Hyperostosis). Enthesophytes may increase in size in older individuals as a result of the cumulative effect of stress on the muscle attachment sites over the lifetime of the individual (Mann and Murphy 1990, 91). However, aged 30–35 years at the time of his

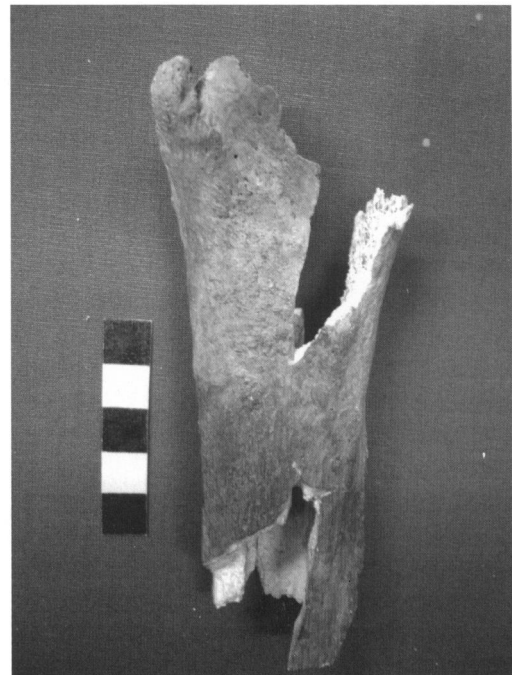


FIG. 21. Enthesophytosis on the tibial tuberosity of the right tibia of MYC2, IV.



FIG. 22. Enthesophytosis on the posterior portion of the left calcaneus (site of attachment of tendons) of MYC2, IV.

death, MYC2, IV was not very old. As no vertebrae were available, DISH could not be securely diagnosed (Mann and Murphy 1990, 51). Ossification of tendons and ligaments is also associated with myositis ossificans (Aufderheide and Rodríguez-Martín 1998, 25) and fluorosis (Ortner 2003). The latter was rejected as there was no brown staining of the enamel of his teeth, which is the first noticeable effect of this condition. Lesions in myositis ossificans are more irregular in form, and their origin on the bone is less clear than those recorded on this skeleton. Moreover, this condition is common among individuals described as 'bone formers'. These people develop enthesophytes, and osteophytes marginally to articular

surfaces, and their cartilage and/or sacro-iliac joints tend to ossify (Rogers and Waldron 1995, 53). In this individual slight lipping was observed on only two of the articular surfaces examined: on the right patella, and on half of the incomplete (70%) rim of the glenoid fossa of the right scapula. In the absence of any other pathological modifications on either of the two articular surfaces (such as pitting, new bone formation, and/or eburnation), lipping is not pathognomonic of osteoarthritis of either the knee or the shoulder joint and it is probably non-pathological (Rogers and Waldron 1995, 26). As MYC2, IV was not old (not more than 35 years), hypertrophy of muscle attachment sites and ossification of tendons and ligaments observed on his skeleton probably reflect excessive mechanical stress and repeated trauma to his muscles, tendons, and ligaments, as part of a strenuous physical life. Moreover, the severity and extent of this condition may be associated with his predisposition to bone formation.

Finally, new (reactive) bone was deposited on the medial surface of the proximal shaft of the right tibia. The area affected measures 66 mm × 30 mm, but owing to post-depositional damage, the full extent of this lesion cannot be evaluated. This probably represents an inflammatory response of the periosteum to a non-specific infection or trauma (Ortner and Putschar 1981, 132; White and Folkens 2000, 392). Because the new bone is remodelled one can infer that the infection was not active at the time of death.

A final general observation for the remains of MYC2, IV concerns the presence of new bone in the form of small granules not only on sites of muscle insertion on the skeleton that probably reflects a non-specific infection.

Grave IV, Individual 3 (MYC3, IV)

This individual may be identified as individual O in Stamatakis's reports and is represented by cranial fragments (cranium 25% complete), one maxillary bone (30%), two joining mandibular fragments (75%), and the post-cranial skeleton C (20% complete) (TABLE 17).

This individual was identified as male on the basis of the shape of his nuchal crest, left

TABLE 17. Individual MYC3, IV: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	40%, 1 fragment					
Left scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	1	o%	o%	75%	70%	o%
Left radius	o	o%	o%	o%	o%	o%
Left ulna	o	o%	o%	o%	o%	o%
Left femur	o	o%	o%	o%	o%	o%
Left tibia	2	90%	25%	75%	75%	o%
Left fibula	o	o%	o%	o%	o%	o%
Left innominate	o					
Left hand	Carpals Metacarpals Phalanges	o o o				
Left foot	Tarsals Metatarsals Phalanges	Calcaneus (90%) o o				
Left patella	~100%, 1 fragment					
Right clavicle	100%, 1 fragment					
Right scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	1	o%	o%	70%	100%	90%
Right radius	1	o%	o%	65%	100%	o%
Right ulna	o	o%	o%	o%	o%	o%
Right femur	2	o%	o%	85%	25%	o%
Right tibia	o	o%	o%	o%	o%	o%
Right fibula	o	o%	o%	o%	o%	o%
Right innominate	o					
Right hand	Carpals Metacarpals Phalanges	o o o				
Right foot	Tarsals Metatarsals Phalanges	o o o				
Right patella	o					
Sternum	o					
Vertebrae	Cervical		Thoracic		Lumbar	
	o		o		o	
Sacrum	o					
Left ribs	o					
Right ribs	o					

supra-orbital ridge, right mastoid process, his mental eminence, and the squaring-off of the anterior mandibular region. His age at death was estimated between 20 and 25 years on the degree of cranial suture closure. Data on dental development—erupting mandibular right

TABLE 18. Individual MYC3, IV: dental measurements (maxillary and mandibular) (mm) (Nafplioti 2007), and other information.

Maxillary teeth L side	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
I 1st					Yes	
I 2nd					Yes	
C					Yes	
Pm3	9.70	7.25				
Pm4	9.75	6.85				
M1	12.20	10.80				
M2	12.20	10.70				
M3					Yes	
Maxillary teeth R side						
I 1st						
I 2nd						
C						
Pm3						
Pm4						
M1						
M2						
M3						
Mandibular teeth L side						
I 1st					Yes	
I 2nd					Yes	
C					Yes	
Pm3					Yes	
Pm4	9.00	7.40	2			
M1	10.90	11.70	3	17-25 years		
M2	10.45	11.00	2			
M3					Erupting	
Mandibular teeth R side						
I 1st						
I 2nd						
C					Yes	
Pm3	8.80	7.40	2			
Pm4					Yes	
M1	11.10	11.25	3	17-25 years		
M2	10.50	11.50	2			
M3					Erupting	

and left third molars—and dental attrition suggest a younger age at death for this male, less than 20 years.

The mandible, left humerus, and left tibia had been sampled before this study, and the mandibular left first molar was sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ (Nafplioti 2009). Dental measurements and selected cranial, post-cranial, and dental non-metrics recorded for this individual are given in TABLES 18, 28, 29, 30, and 31 respectively.

Dental chart of MYC3, IV

Upper Right								Upper Left							
[]	[]	[]	[]	[]	[]	[]	[]	PM	PM	PM	✓	✓	✓	✓	PM
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
✓	✓	✓	PM	✓	PM	[]	[]	PM	PM	PM	PM	✓	✓	✓	✓
Lower Right								Lower Left							

Dental pathology and non-pathological observations. There is no sign of caries on any of the ten erupted teeth present. Slight intermittent calculus was recorded on the crowns of eight of them: the mandibular right first and second molars, the mandibular left second premolar and second molar, the maxillary left first and second premolars, and first and second molars.

Finally, we think that the tooth identified by Angel as a mandibular left canine is instead a mandibular right first premolar. The right and left mandibular third molars were erupting at the time of the death of MYC3, IV.

Carabelli's cusp is present on the maxillary left first molar. This is an additional cusp on the palatal side of the mesio-palatal cusp of the crown that most frequently occurs on maxillary first molars (Dahlberg 1945). It is a non-metric dental trait (Turner *et al.* 1991: see 'Methods' section).

Pathological and non-pathological skeletal modifications. As with MYC1, IV and MYC2, III, small arachnoid granulation pits with regular walls were observed on the endocranial surface of the parietals of MYC3, IV. They occurred parallel to the sagittal suture, the largest measuring 4.5 mm × 3.5 mm.

Enthesophytosis on muscle attachment sites on the right and left clavicles probably suggests excessive mechanical stress on the pectoral girdle of this individual while he carried out his physical activities. Enthesophytosis on the costal impression is considerable on the right clavicle and slight on the left. The costal impression lies on the medial end of the clavicle and is the enthesis for the costoclavicular ligament (costal impression) which supports the sternoclavicular joint (White and Folkens 2000, 167). Moreover the shaft of each is squared off antero-medially, which probably reflects excessive mechanical loading of the pectoralis muscle (FIG. 23). The pectoralis major is inserted on the antero-medial portion of the clavicular shaft.

Finally, the conoid tubercle on the right clavicle is moderately pronounced. The conoid tubercle is the enthesis for the conoid ligament which supports the scapulo-clavicular joint (White and Folkens 2000, 168). According to Capasso *et al.* (1999, 39) osseous modifications



FIG. 23. Medial end of right clavicle of MYC₃, IV, showing enthesophytosis on costal impression.



FIG. 24. Periostitis on right femur of MYC₃, IV.

in this skeletal region are associated with generalized stress on the pectoral girdle, particularly forward bending of the body while moving heavy loads or hanging them from the shoulders, hunting, and other rigorous working conditions.

Hypertrophy of the linea aspera was observed on the right femur. Not only is it thick (9.0 mm), but the underlying structure of the femoral shaft also shows extra development. This condition—*pilasterism*—is a non-pathological activity-related skeletal modification associated with high mechanical loading of the muscles directly attached to the linea aspera (Capasso *et al.* 1999, 103–4). See also comments above on the linea aspera of MYC₁, III.

On the anterior surface of the right femoral midshaft there is new (reactive) bone formation, which is associated with periostitis (FIG. 24): for its aetiology see on MYC₂, IV. The formation of new bone is prolific. Most of this is remodeled, but there is also some woven bone, suggesting that this individual had not overcome the relevant infection by his death, and that his death may be associated with it. Despite post-depositional damage to the proximal shaft that obstructs recording the extent of the affected area, new bone clearly covers an area of 60 mm × 15 mm on the bone

present. Inferior to this area of woven bone less severe periostitis was recorded on the lateral surface of the femoral shaft. The new bone is less prolific and lamellar (remodelled), suggesting a past infection. Moreover, on part of the distal shaft there is roughening of the sub-periosteal surface resulting from the deposition of irregular (lamellar) bony outgrowths. Analogous small-sized bony outgrowths and one medium-sized outgrowth were observed on the posterior surface of the proximal shaft, inferior to the fibular facet, and on the medial midshaft area of the left tibia. They are also associated with periostitis. Finally, moderate roughening of the popliteal line is probably mechanical in origin.

All articular surfaces observed were non-pathological.

Grave IV, Individual 4 (MYC₄, IV)

MYC₄, IV, identified as individual Σ in Stamatakis's report because this letter is written in pencil on the endocranial surface of one of the cranial fragments, is represented by an incomplete cranium (25%) and mandible (15%). The greenish colour of these skull fragments resembles that of the remains of MYC₂, III.

The mandibular morphology suggests it probably belonged to a female. From limited evidence of sutural closure an age at death of between 20 and 25 years is suggested. Her dental age could not be determined owing to post-mortem tooth loss.

Selected cranial non-metrics recorded for this individual are given in TABLE 28.

Pathological skeletal modifications. Cribra orbitalia were observed on the left orbit of MYC₄, IV. The porosity is faint and covers an area of 5.0 mm $\times$ 3.5 mm. Its extent on the left orbit could not be evaluated fully because of post-depositional damage. For the aetiology of cribra orbitalia see the relevant section on MYC₂, III.

In addition, small pits on the endocranial surface resemble those on the cranium of MYC₁, IV and are identified as arachnoid granulation pits.

Grave IV, Individual 5 (MYC₅, IV)

This individual is poorly represented by fragments of the left parietal (35%), left temporal (80%), and the occipital (30%) that comprise 25% of the complete cranium. An incomplete axis vertebra (85%) was associated with it on grounds of similarities in colour and preservation.

TABLE 19. Mandible 4, Grave IV: dental measurements (mandibular) (mm) (Nafplioti 2007), and other information.

Mandibular teeth L side	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
I 1st						
I 2nd						
C						
Pm3						
Pm4						
M1						
M2						
M3						
Mandibular teeth R side						
I 1st						
I 2nd						
C						
Pm3					Yes	
Pm4					Yes	
M1	10.35	10.85	3	17–25 years		
M2	9.80	10.85	2			
M3						

As the left mastoid process, damaged inferiorly, is less voluminous and the nuchal crest less prominent than the corresponding features on definite male crania from Graves IV and V, it is suggested this was probably a female. Despite the incompleteness of the skeleton, the degree of closure of those portions of the coronal and lambdoid sutures that could be recorded suggests that she was probably older than 25 years, but not more than 30 to 35 years at the time of death.

Grave IV, other commingled skeletal material

Mandible 4, IV (25% complete) was found in the boxes containing skeletal material from Grave IV and cannot be confidently associated with MYC₅, IV, who is the only one from the Grave IV individuals without a mandible. There is, however, no other cranium from this grave with which it matches better than the latter. The degree of wear on the first and second molars suggests that it belonged to a young adult aged between 17 and 25 years at death. However this is a much lower estimate than that suggested by the cranial remains of MYC₅, IV. Little more can be said about the association of MYC₅, IV with Mandible 4, IV because the skeletal material present is too incomplete.

This mandible had been sampled before this study and the mandibular right first molar was sampled for ⁸⁷Sr/⁸⁶Sr analysis (Nafplioti 2009). Dental measurements and selected dental non-metrics for Mandible 4, IV are given in TABLES 19 and 31 respectively.

Dental chart of Mandible 4, IV

48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
[]	✓	✓	PM	PM	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
Lower Right								Lower Left							

Dental pathology. Only two teeth (right first and second molars) were present in Mandible 4, IV. Slight to medium intermittent calculus was scored on the crown of both teeth. No carious lesions or other pathology was recorded on either of them.

Maxilla A, IV and Maxilla B, IV. Two additional maxillary fragments were found with material from Grave IV. Specimen A (Maxilla A, IV) is an incomplete (15%) left maxilla containing one tooth: the left first premolar.

Dental chart of Maxilla A, IV

Upper Right								Upper Left							
[]	[]	[]	[]	[]	[]	[]	[]	PM	PM	PM	✓	PM	AM	[]	[]
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28

Specimen B (Maxilla B, IV) represents an incomplete (10%) right maxilla. Four teeth are present; their size and the degree of wear suggest that they probably belonged to a female aged 35–40 years. Considerable resorption of the alveolar bone may perhaps be associated with severe dental attrition: grades 4 to 6 in Molnar's attrition scoring system (see too Brothwell 1981, 154).

Dental chart of Maxilla B, IV

Upper Right								Upper Left							
✓	✓	✓	✓	PM	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28

None of the five teeth present in these two maxillary fragments had any carious lesions. Nor could they be assigned confidently to any of the individuals from Grave IV, or associated with Mandible 4, IV, on grounds of dental attrition and eruption data, tooth size, bone colour, and preservation.

A fragment of a right femoral shaft (30% of the complete bone) found with the post-cranial material from the Grave IV could not confidently be associated with either MYC₄, IV or MYC₅, IV. Enthesophytosis of the linea aspera was observed on the posterior surface of the distal shaft of this bone; medium- to large-sized irregular enthesophytes were deposited in a line running laterally to the medial border of the linea aspera. The adductor tubercle on the medial supracondylar ridge—the site of attachment of the vertical fibres of adductor magnus—was also moderately developed. The adductor magnus helps to adduct the thigh at the hip (White and Folkens 2000, 239). ‘Islands’ of new irregular bony outgrowths in the form of small granules were also observed on the sub-periosteal bone surface and probably reflect periostitis (see on MYC₂, IV).

Twenty animal bone fragments from at least one pig and more than one sheep/goat and cow were found in the boxes with skeletal material from Grave IV.

GRAVE V

In his report Angel (1973, 384) described and published skeletal measurements on only two individuals from Grave V, 25 Myc. and 26 Myc. There the former is represented by both cranial and post-cranial material; the latter by cranial material only. Moreover, Schliemann (1880) commented on the size and the very good preservation of the leg bones of the three individuals from this grave and emphasized the exceptional preservation of the skull of one of them, individual Φ according to Stamatakis’s record.

Grave V, Individual 1 (MYC₁, V)

This is probably individual T in Stamatakis’s report. On grounds of skeletal robusticity, the skull of individual 26 Myc. in Angel’s report, for which he did not mention any post-cranial material, was associated with the post-cranial skeleton of individual 25 Myc. in the same report and now comprises individual MYC₁, V here. This individual’s left humerus is reported by Stamatakis to have been exhibited in the Museum with the gold jewellery found with it. The preservation, completeness, and large size of the lower limb bones of MYC₁, V match Schliemann’s description of the remains of this individual well (Schliemann 1880, 295–6).

The cranium and mandible are respectively 30% and 70% complete. The right first molar, which was present in its socket when Angel examined the mandible (see Angel 1973, pl. 287), is missing. The post-cranial skeleton is incomplete (40%) and is mainly represented by long bones (TABLE 20). Damage to articular ends is not infrequent and small bones are missing.

TABLE 20. Individual MYC1, V: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	~100%, 1 fragment					
Left scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	2	15%	30%	65%	0%	0%
Left radius	0	0%	0%	0%	0%	0%
Left ulna	0	0%	0%	0%	0%	0%
Left femur	3	50%	30%	100%	95%	95%
Left tibia	1	0%	5%	95%	100%	100%
Left fibula	0	0%	0%	0%	0%	0%
Left innominate	o					
Left hand	Carpals Metacarpals Phalanges	o o o				
Left foot	Tarsals Metatarsals Phalanges	Calcaneus (30%) o o				
Left patella	95%, 1 fragment					
Right clavicle	~100%, 1 fragment					
Right scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	2	25%	85%	100%	100%	15%
Right radius	1	80%	95%	100%	80%	0%
Right ulna	1	95%	90%	100%	80%	0%
Right femur	1	80%	95%	95%	100%	100%
Right tibia	1	0%	10%	100%	100%	100%
Right fibula	0	0%	0%	0%	0%	0%
Right innominate	30%, 1 fragment					
Right hand	Carpals Metacarpals Phalanges	o o o				
Right foot	Tarsals Metatarsals Phalanges	Calcaneus (95%), talus (95%) o o				
Right patella	o					
Sternum	o					
Vertebrae	Cervical		Thoracic		Lumbar	
	Atlas (95%)		1 thoracic (95%)		2 lumbar (~100%)	
Sacrum	o					
Left ribs	o					
Right ribs	o					

Post-cranial elements are marked with the roman number V. Preservation of bone and dental enamel is very good.

The morphology of the nuchal line on the occipital bone and the mastoid process, the

TABLE 21. Individual MYC1, V: dental measurements (maxillary and mandibular) (mm) (Nafplioti 2007), and other information.

Maxillary teeth L side	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
I 1st	7.45	8.80	4			
I 2nd	6.60	6.45	3			
C	8.90	8.25	2			
Pm3	8.50	7.45	2			
Pm4	9.20	7.00	2			
M1	11.70	11.00	3		17-25 years	
M2	11.60	10.50	2			
M3	10.60	9.25	3			
Maxillary teeth R side						
I 1st						
I 2nd						
C						
Pm3						
Pm4						
M1						Yes
M2	11.65	11.75	2	17-25 years		
M3	10.35	10.85	2			
Mandibular teeth L side						
I 1st						
I 2nd						
C						
Pm3	7.45	6.00	2			
Pm4	8.55	7.10	2			
M1	11.00	11.45	3	17-25 years		
M2	10.50	10.80	2			
M3	9.65	10.65	2			
Mandibular teeth R side						
I 1st						
I 2nd						
C						
Pm3						
Pm4	8.20	7.00	2			
M1	11.00	11.45	3	17-25 years		
M2		10.90	2			
M3	10.00	11.75	2			

TABLE 22. Individual MYC1, V: post-cranial measurements (mm)
(Buikstra and Ubelaker 1994).

Skeletal element	Side	Measurement	Value
Clavicle	Left	Maximum length	166.5
Clavicle	Right	Maximum length	149.0
Femur	Left	Maximum length	503.0
Femur	Right	Epicondylar breadth	79.7

gonial flaring of the mandible, and the robusticity of the post-cranial skeleton indicate a definite male individual. On the degree of closure of portions of the lambdoid and sagittal sutures observable on the cranial fragments present MYC1, V was 25 to 35 years old at death. The degree of dental wear suggests that this individual was probably around 25 years old.

He retained to adulthood a patent metopic suture (Berry and Berry, 1967) (FIG. 25). This is a cranial non-metric trait and its presence/absence is non-pathological (Saunders 1989). The stature of this individual was calculated from the left femur as 1.81 m ($\pm$ 3.27 cm).

The mandible and the right humerus had been sampled before this study and the mandibular left first molar was sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ analysis (Nafplioti 2009). Dental and post-cranial measurements and selected cranial, post-cranial and dental non-metrics recorded for this individual are given in TABLES 21, 22, 28, 29, 30, and 31 respectively.

Dental chart of MYC1, V

Upper Right								Upper Left							
										EH	EH				
✓	✓	PM	[]	[]	[]	[]	[]	✓	✓	✓	✓	✓	✓	✓	✓
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
✓	✓	✓	✓	[]	[]	[]	[]	[]	[]	[]	✓	✓	✓	✓	✓
		CIP									EH				
Lower Right								Lower Left							

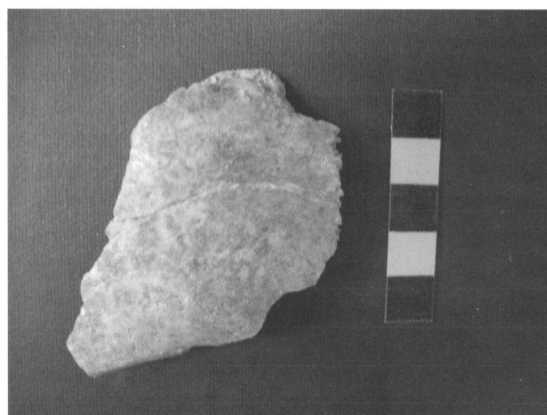


FIG. 25. Metopic suture, MYC1, V.

Dental pathology and non-pathological observations. Only one of the nineteen teeth examined had a small carious lesion. It is located on the interproximal crown surface on the disto-buccal cusp of the mandibular right first molar.

Intermittent slight calculus is present on the maxillary left second incisor, left canine, left first premolar, left second premolar, left first molar, left second molar, right second molar, and right third molar, and the mandibular right second premolar, right first molar, left first premolar, left third molar. Medium calculus is present on the mandibular right third molar, right second molar, left second premolar, and left second molar.

Three slight hypoplastic lines were recorded on the buccal surface of the maxillary left canine and two on each of the maxillary and mandibular left first premolars. They probably reflect episodes of stress in the early childhood of this individual (see also MYC₁, III, MYC₂, III, and MYC₁, IV above). Enamel fractures on the maxillary left first (central) incisor and the mandibular right second molar are probably post-depositional.

The frequency of non-metric traits on the teeth of this individual is relatively high (FIG. 26). The following were recorded: shovelling on the palatal surface of the maxillary left second (lateral) incisor, Carabelli's cusp (see on MYC₃, IV above) on the maxillary left first molar, and parastyles on the maxillary left and right second molars.

Pathological and non-pathological skeletal modifications. The walls of the cranium of MYC₁, V are thick: 9.9 mm on the left parietal. Although porotic hyperostosis was not observed on any of the cranial fragments present and cribra orbitalia could not be scored, hypertrophy of the diploë may suggest that this individual suffered from thalassaemia or iron-deficiency anaemia (Ortner 2003, 89; see also MYC₂, III above).

This is the most robust skeleton in the GCA collection. Slight to considerable enthesophytosis was recorded on muscle attachment sites on the upper and lower limbs, probably associated with physical activities. Some pathological modifications were also observed.

Considerable enthesophytosis was recorded on the costal impression on the medial end of the right clavicle. The costal impression is located on the inferior surface of the medial end

of the clavicle and is the enthesis of the costoclavicular ligament. Hypertrophic development here is associated with high mechanical loading of the sternoclavicular joint in the performance of physical activities (White and Folkens 2000, 167). The left clavicle is only moderately modified here. Likewise, excessive mechanical stress of the pectoralis major is indicated by the squaring-off of the anterior portion of the medial half of the shaft of each clavicle. The moderate hypertrophy of the enthesis for the conoid ligament—the conoid tubercle—on the postero-inferior portion of the lateral end of the clavicle is probably also activity-related; as may be the slight roughening of the site of attachment of deltoid on the antero-superior surface of the lateral end of each clavicle. All



FIG. 26. Shovelling on the maxillary left lateral incisor, Carabelli's cusp on maxillary left first molar, and parastyle on maxillary left second molar of MYC₁, V.

these modifications probably reflect generalized stress on the pectoral girdle (Capasso *et al.* 1999, 39; for more information see the relevant section on MYC3, IV).

Additional evidence of relatively high mechanical stress on the upper skeleton is provided by hypertrophy of the entheses of *teres major*—the crest of the lesser tubercle—where it is slight on the right humerus and moderate on the left (White and Folkens 2000, 183); of *pronator teres* (slight) on the right radius; of *brachialis*—the ulnar tuberosity—(slight) and *supinator*—the supinator crest—(moderate) on the proximal shaft of the right ulna (Mann and Murphy 1990, 90–1; White and Folkens 2000, 192).

The hypertrophic development of the gluteal line (moderate) on the right femur and the *linea aspera* (moderate) and the adductor tubercle (considerable) on each femur suggests excessive mechanical stress on the lower limbs too. In addition, there is a trace of *pilasterism* on the right femur, at the site of the *linea aspera*. It is smaller than that recorded on MYC3, IV.

On the right tibia, the popliteal line is roughened by medium-sized irregular, perhaps activity-related enthesophytes. Small enthesophytes, in the form of bony spicules, were also recorded on the superior portion of the attachment of the quadriceps tendon on the anterior surface of the right patella (Mann and Murphy 1990, 120).

On the postero-medial surface of the distal shaft of the right tibia there is an area of new bone formation (FIG. 27). It is lamellar (remodelled) and may be interpreted either as an ossified haematoma (blood clot) resulting from a wound inflicted on the bone (Kullmann and Wouters 1972), or as a callus formed on the site of a healed stress fracture. Firm diagnosis of the latter would be possible by means of X-ray examination. There is an area of medium-sized osteophytes on the medial surface of the right tibial distal shaft, immediately anterior to the malleolar groove and measuring 14 mm × 14 mm. On the lateral surface of the bone, superior to the fibular notch, there is an area of similar changes measuring 37 mm × 11 mm. The osteophytes possibly reflect high pulling stresses of the interosseous membrane and tendons respectively, and may support the diagnosis of a stress fracture (Mann and Murphy

1990, 121; White and Folkens 2000, 245). Further support comes from the absence of such modifications on the left tibia. Moreover, slight lipping on the articular surface on the distal right tibia and the corresponding articular surface on the postero-medial portion of the trochlea of the right talus (medial malleolar surface) may be the result of trauma (White and Folkens 2000, 261). The absence of lipping on the left tibio-talar articulation supports this interpretation.

Slight enthesophytosis was recorded on the site of attachment of the Achilles tendon on the right calcaneus. Enthesophytes here are associated with repeated or acute trauma of the Achilles



FIG. 27. Callus on the distal shaft of the right tibia of MYC1, V.

tendon (Mann and Murphy 1990, 129). Bilateral occurrence of enthesophytosis here could not be recorded because of post-depositional damage to the left calcaneus.

A lumbar vertebra found with material from Grave V is probably associated with this individual. Its body is wedged antero-laterally, and a fracture line was observed on the anterior portion of the right half of the body (FIG. 28). The morphology of the vertebra suggests a compression fracture. Such fractures result from sudden excessive impaction (Ortner and Putschar 1981, 57). New bone formation at the site of this fracture indicates that the individual survived long enough afterwards for healing to begin.

Except for the right distal tibia and talus, no pathological modifications were observed on any of the recorded articular ends of this skeleton. Slight marginal lipping (osteophytosis) was scored on 25% of the rim of the superior endplate of the lumbar body mentioned above. It is possibly related to the fracture.



FIG. 28. Compression fracture of a lumbar vertebra of MYC1, V (anterior view).

Individual 2, Grave V (MYC2, V)

This is probably individual Y in Stamatakis's report. On the endocranial surface of the frontal bone is written in pencil 'V 2327'. The catalogue number '2327' in that report is assigned to finds associated with individual Y and particularly to the 'bones of these dead people'.

The skeleton is very incomplete. It is represented by the skull of individual 25 Myc. in Angel's report and three post-cranial elements (TABLE 23). The incomplete skull comprises 35% of the cranium and 40% of the mandible. The incomplete left humerus and right femur associated with this individual were found with post-cranial material from Grave IV, but were assigned to MYC2, V on close similarities in bone robusticity and preservation between MYC1, V and MYC2, V. Although skeletal completeness is poor, preservation of bone and dental enamel is very good.

Based on the morphology of the supra-orbital ridges and glabella and the inclination of the forehead on the cranium, this is a definite male. His age at death, determined from the degree of closure of the observable parts of the coronal and sagittal sutures, was between 30 and 35 years. This agrees with a dental age-estimate derived from enamel wear of 25 to 35 years.

The femur and the mandible had been sampled before this study and the mandibular left first molar was sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ (Nafplioti 2009). Cranial and dental measurements and selected cranial, post-cranial and dental non-metrics recorded for this individual are given in TABLES 24, 25, 28, 29, 30, and 31 respectively.

TABLE 23. Individual MYC2, V: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	o					
Left scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	1	o%	o%	o%	4o%	5%
Left radius	o	o%	o%	o%	o%	o%
Left ulna	o	o%	o%	o%	o%	o%
Left femur	o	o%	o%	o%	o%	o%
Left tibia	o	o%	o%	o%	o%	o%
Left fibula	o	o%	o%	o%	o%	o%
Left innominate	o					
Left hand	Carpals Metacarpals Phalanges	o o o				
Left foot	Tarsals Metatarsals Phalanges	Talus (95%) o o				
Left patella	o					
Right clavicle	o					
Right scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	o	o%	o%	o%	o%	o%
Right radius	o	o%	o%	o%	o%	o%
Right ulna	o	o%	o%	o%	o%	o%
Right femur	2	95%	9o%	45%	o%	o%
Right tibia	o	o%	o%	o%	o%	o%
Right fibula	o	o%	o%	o%	o%	o%
Right innominate	o					
Right hand	Carpals Metacarpals Phalanges	o o o				
Right foot	Tarsals Metatarsals Phalanges	o o o				
Right patella	o					
Sternum	o					
Vertebrae	Cervical		Thoracic		Lumbar	
	o		o		o	
Sacrum	o					
Left ribs	o					
Right ribs	o					

Dental chart of MYC2, V

Upper Right								Upper Left							
✓	✓	✓	✓	✓	✓	✓	PM	PM	PM	✓	✓	✓	✓	✓	✓
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
PM	✓	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	PM	✓	✓	✓
Lower Right								Lower Left							

Dental pathology and non-pathological observations. MYC2, V had very good dental health. No carious lesions were recorded on the seventeen teeth present and no tooth was lost ante-mortem. Slight intermittent calculus is present on the maxillary right second incisor, right canine, right first and second premolars, right second and third molars, left second premolar, first, second, and third molars, and the mandibular left second and third molars, and right second molar. Medium calculus is present on the maxillary right second molar. Shovelling of the crown was recorded on the maxillary right second (lateral) incisor (FIG. 29).

Pathological and non-pathological skeletal modifications. MYC2, V has relatively thick cranial walls: 9 mm on the right parietal. Although hypertrophy of the diploë was not accompanied by either cribra orbitalia or porotic hyperostosis, thalassaemia or iron-deficiency anaemia may have been implicated, as noted for MYC2, III and MYC1, V. In addition, on the endocranial surface of the right frontal, lateral to the frontal crest, there is a small area of thickened bone that bulges endocranially, which may be associated with an early stage of hyperostosis frontalis interna (see the relevant section on MYC3, III).

On the head of the right femur, there is an area (16.5 mm × 9.0 mm) of new (lamellar)



FIG. 29. Shovelling on the maxillary right lateral incisor of MYC2, V.

TABLE 24. Individual MYC2, V: cranial measurements (mm) (Howells 1973).

Measurement	Abbreviation	Value
Bifrontal breadth	FMB	108?
Nasion–bregma chord	FRC	115.0

TABLE 25. Individual MYC2, V: dental measurements (maxillary and mandibular) (mm) (Nafplioti 2007), and other information.

Maxillary teeth L side	Bucco-lingual	Mesio-distal	Wear (Molnar 1971)	Wear (Brothwell 1981)	Lost PM	Lost AM
I 1st					Yes	
I 2nd					Yes	
C	8.75	7.65	4			
Pm3	8.90	6.55	3			
Pm4	8.90	6.55	4			
M1	11.60	10.75	4	25-35 years		
M2	11.50	10.10	3			
M3	11.75	10.10	3			
Maxillary teeth R side						
I 1st					Yes	
I 2nd	6.10	6.75	3			
C	8.40	7.60	3			
Pm3	9.00	6.30	3			
Pm4	8.65	6.15	4			
M1	11.40	11.45	4	25-35 years		
M2	11.00	11.25	3			
M3	10.35	9.25	3			
Mandibular teeth L side						
I 1st						
I 2nd						
C						
Pm3						
Pm4					Yes	
M1	10.80	11.75	4	25-35 years		
M2	10.00	10.00	4			
M3	10.55	11.15	3			
Mandibular teeth R side						
I 1st						
I 2nd						
C						
Pm3						
Pm4						
M1						
M2	10.40	10.85	4	25-35 years		
M3					Yes	

bone formation on the articular surface, superior and posterior to the fovea capitis. Because no other pathological modifications, such as porosity or eburnation on the articular surface or marginal osteophytes on the rim (60% complete), are present on the femoral head, it is not possible to diagnose osteoarthritis of the right hip-joint (Rogers and Waldron 1995, 26).

Individual 3, Grave V (MYC3, V)

MYC3, V is represented by fragments of the left (25%) and right (15%) parietal bones, the occipital (<10%), the right (40%), and left (30%) temporal bones. The cranium is less than 20% complete and its ectocranial surface is weathered.

The degree of closure of those portions of the lambdoid suture that could be assessed suggests that this individual was probably older than 25 years at death. The prominence of the nuchal line on the occipital bone and the morphology of the mastoid processes suggest he was male. Cranial non-metrics recorded for him are given in TABLE 28.

Pathological skeletal modifications. His left parietal was 9.0 mm thick. Hypertrophy of the diploë may be attributed to a similar cause to that on MYC2, III, MYC1, V and MYC2, V (see relevant sections above).

Individual 4, Grave V (MYC4, V)

The cranium of MYC4, V is 20% complete and was reconstructed from fragments of the frontal bone, right and left parietals, and the occipital bone. The post-cranial skeleton is 25% complete (TABLE 26). The sub-periosteal bone surface is weathered and bears longitudinal cracks.

The external occipital protuberance matches the maximal expression of Buikstra and Ubelaker's scoring system (1994) for males (FIG. 30). It projects inferiorly 9.0 mm from the superior nuchal line on the squamous portion of the bone and forms a well-defined bony 'hook' (breadth 10.0 mm). The nuchal lines anchor several muscles that act to extend and rotate the head (White and Folkens 2000, 78) and the external occipital protuberance is more prominent in males than females. Sex-determination from the post-cranial skeleton was not so clear. However, even though the innominate bones and sacrum are absent, the robusticity of the post-cranial skeleton suggests this was probably a male individual. It was however less robust than the post-cranial skeletons of MYC1, V and MYC2, V. Closure of the sagittal and lambdoid sutures (where observable) suggested an age at death of between 25 and 30 years for this individual.

Finally, a metopic suture is present on a fragment of his frontal bone, as on MYC1, V's from the same grave. Selected cranial non-metrics recorded for this individual are given in TABLE 28.

Pathological and non-pathological skeletal modifications. New porotic bone was observed

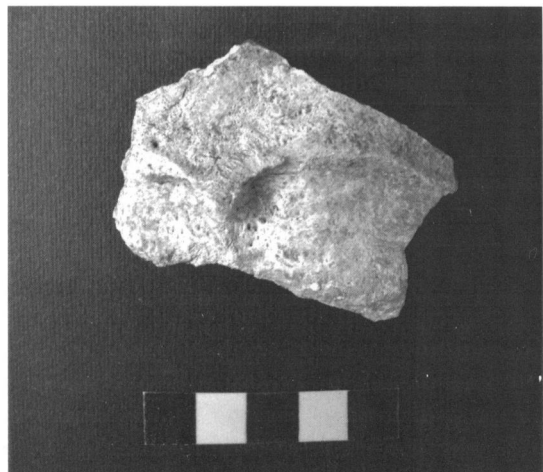


FIG. 30. Nuchal crest on occipital bone of MYC4, V.

TABLE 26. Individual MYC4, V: post-cranial skeletal material.

Skeletal element	Completeness (%) and no. of fragments					
Left clavicle	80%, 1 fragment					
Left scapula	o					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Left humerus	1	o%	70%	100%	80%	o%
Left radius	o	o%	o%	o%	o%	o%
Left ulna	1	o%	60%	100%	15%	o%
Left femur	1	o%	70%	15%	o%	o%
Left tibia	1	o%	5%	75%	90%	o%
Left fibula	o	o%	o%	o%	o%	o%
Left innominate	o					
Left hand	Carpals Metacarpals Phalanges	o o o				
Left foot	Tarsals Metatarsals Phalanges	o 2nd (~100%) o				
Left patella	o					
Right clavicle	o					
Right scapula	30%, 1 fragment					
	No. of fragments	Proximal epiphysis	Diaphysis			Distal epiphysis
			Proximal 1/3	Middle 1/3	Distal 1/3	
Right humerus	1	o%	90%	35%	o%	o%
Right radius	2	o%	80%	95%	50%	o%
Right ulna	o	o%	o%	o%	o%	o%
Right femur	1	o%	80%	30%	o%	o%
Right tibia	1	o%	10%	60%	10%	o%
Right fibula	o	o%	o%	o%	o%	o%
Right innominate	o					
Right hand	Carpals Metacarpals Phalanges	o 4th (~100%), unidentified (80%) 1 proximal (~100%)				
Right foot	Tarsals Metatarsals Phalanges	o o o				
Right patella	o					
Sternum	o					
Vertebrae	Cervical		Thoracic		Lumbar	
	o		o		o	
Sacrum	o					
Left ribs	o					
Right ribs	o					

on both the right and left parietals. The new bone is remodelled and the area affected measured 34 mm × 15 mm on the right and 30 mm × 18 mm on the left. Post-depositional damage did not permit a full assessment of the extent of these lesions. As there is no sign of

hypertrophy of the diploë and the sub-periosteal new bone appears to be superficial to the cranial vault, anaemia may be excluded as the cause (Ortner and Putschar 1981, 137). Instead, a past infectious disease may be a more plausible explanation (Ortner and Putschar 1981, 263).

The presence of slight to considerable enthesophytosis on muscle attachment sites on the upper and lower limbs of MYC4, V may be interpreted as evidence of high mechanical loading on this individual's musculo-skeletal system during physical activities.

The crests of the greater and lesser tubercles—the insertion sites for muscles that act to medially rotate (subscapularis), laterally rotate (infraspinatus, teres minor), abduct (supraspinatus, infraspinatus) and weakly adduct (teres minor) the humerus (White and Folkens 2000, 183)—and the intertubercular sulcus on each humerus displayed moderate roughening from the formation of medium-sized enthesophytes. The intertubercular sulcus starts from the proximal humeral shaft between the two tubercles and extends downwards along the vertical axis of the bone. Roughening here may reflect high stress on the tendon of the long head of the biceps brachii muscle (White and Folkens 2000, 182).

Considerable roughening on the right ulnar tuberosity, and slight thickening of the interosseous crest on both ulnae—less marked on the left—may also be activity-related, as may be the slight roughening of the site of insertion of the pronator teres muscle on the right radius (Mann and Murphy 1990, 91). The ulnar tuberosity is located disto-medially to the coronoid process on the anterior proximal ulnar shaft and is the insertion of the brachialis muscle on the ulna. This muscle originates from the humerus and helps to flex the elbow (White and Folkens 2000, 192).

On the lower limb moderate enthesophytosis was observed on the gluteal and spiral lines on each femur. There is also slight hypertrophic development of the linea aspera on both bones. All this may suggest elevated mechanical stress of the gluteus maximus, adductors longus, brevis, and magnus, and the vastus muscles that extend, laterally rotate, and adduct the thigh at the hip (Mann and Murphy 1990, 93; White and Folkens 2000, 233).

Individual 5, Grave V (MYC5, V)

This individual is represented by two cranial fragments that comprise 40% of the left parietal bone. Their ectocranial surface is weathered and there is no sign of closure on the portions of the coronal and lambdoid sutures present. This together with their thickness and texture suggest that they belonged to a very young adult. In the absence of any sexually dimorphic features on this material, the sex of MYC5, V could not be determined.

Individual 6, Grave V (MYC6, V)

This is a highly incomplete skeleton that comprises a single fragment of the frontal bone (25% complete). The portion of the coronal suture present is unfused, and the size and texture of the bone appear to be non-adult. There are no signs of cribra orbitalia on the one-third of the left orbital plate available for recording.

Individual A, Grave V (MYCA, V)

This is individual Φ in Stamatakis's report. It is also the remarkably well-preserved skeleton from Grave V recorded by Schliemann (1880, 293–332) to have been recovered by enclosing the soil containing these skeletal remains in a plaster frame. In 1997, however, when it was

‘excavated’ at the NAM, it yielded only some very poor skeletal fragments (Demakopoulou 2002, 3). Contrary to Schliemann’s description of the exceptional preservation of the skull and 32 teeth of this skeleton, only one small parietal bone fragment and five loose teeth were among the scanty skeletal fragments recovered (TABLE 27).

TABLE 27. Individual A, V: skeletal remains from the plaster case of the ‘mummy’.

Specimen	Skeletal element	Completeness (%) and no. of fragments
1	Cranial bone, probably parietal	<5%, 1 fragment
2	Maxilla, left	<5%, 1 fragment
3	Teeth (5)	1 maxillary right 1st molar, 1 mandibular right 2nd molar, 3 premolars
4	Innominate (ischiopubic ramus), left	5%, 1 fragment
5	Innominate (acetabulum), left	<5%, 1 fragment
6	Innominate (sciatic notch), left	<5%, 1 fragment
7	Femur (condyle)	<5%, 1 fragment
8	Femur (neck and proximal epiphysis), left	<10%, 2 fragments
9	Femur (midshaft), right?	<10%, 1 fragment
10	Femur (proximal shaft), right	<10%, 2 fragments
11	Sacrum	<10%, 1 fragment
12	Vertebra (body)	<25%, 1 fragment
13	Post-cranial small-sized fragments	59

Two of these five teeth—a maxillary left first premolar and a mandibular right second molar—were sampled for $^{87}\text{Sr}/^{86}\text{Sr}$ analysis (Nafplioti 2009). The different colour of their enamel and the degree of attrition indicate that they probably came from two individuals: MYCA1, V and MYCA2, V. The shape of the greater sciatic notch on a fragment of a left innominate (<5% of the complete bone) tentatively suggests that at least one female individual is probably represented in the assemblage from Grave V. Attrition of the enamel is slight on all five teeth, suggesting an age at death ≤ 30 years for the individual(s) present.

Individual B, Graves IV and V (MYCB, IV–V)

At least one infant is represented in the post-cranial skeletal material from Graves IV and V. An incomplete left humerus (40%), comprising the inferior half of the midshaft and the distal shaft of the bone, was present in one of the boxes containing material from Grave V (FIG. 31). Its distal epiphysis was not fused at the time of death and was lost post-mortem. Its estimated maximum diaphyseal length of no more than 125 mm suggests an age of less than 2 years for this individual. The owner of an incomplete (85%) right tibial shaft fragment found with skeletal material from Grave IV was roughly the same age. Its proximal epiphysis was unfused and lost post-mortem. Its distal shaft is broken off and missing.

These two infant bones probably belonged to the same individual (MYCB, IV–V) on grounds of similarity in size, texture, and colour. It seems they were misplaced at some time after excavation.

DISCUSSION AND CONCLUSIONS

The number of individuals from GCA represented by the skeletal remains that we examined in the National Archaeological Museum differs from that based on Schliemann's and Stamatakis's on-site observations and long established in the literature (Dickinson 1977; Kilian-Dirlmeier 1986; Demakopoulou 1990). See TABLE 34 below.

The discrepancy between the two estimates is easy to observe: the skeletal remains from Grave V belong to more than the three individuals reported by Stamatakis, and there are none from Graves I or II. In the case of Grave V, this suggests that some less complete skeletons present in the grave had escaped Stamatakis's identification, and/or that the remains of later burials made above the shaft graves (see Papazoglou-Manioudaki, earlier in this article) may also be present and mingled with the remains of burials from the interior of the shaft graves. In addition, post-excavation mixing of skeletal remains between different graves, evidence for which was presented earlier, may account for both the higher than expected number of individuals in Grave V and the lack of skeletal remains from Graves I and II. Loss of skeletal material due to misplacement in the storerooms of the National Archaeological Museum should not be completely ruled out as a possibility. If post-excavation mixing has taken place, MYCB, IV–V may be the misplaced incomplete skeleton of the infant reported to have been recovered from Grave III.

Because of the post-deposition mixing of this material, the minimum number of individuals was calculated for the collection as a group in order to avoid exaggerating the true number in each grave separately. These human skeletal remains therefore represent a minimum of ten definite adult males and one probable, one definite, and two probable adult females, one probable adult of unknown sex, and one sub-adult, based on cranial material. One infant aged less than two years is represented, by post-cranial material from Graves IV and V. Finally, at least one female is probably represented by the scanty remains of the so-called 'mummy' (MYCA, V) recovered from the plaster-framed soil structure (Demakopoulou 2002, 3). The results of this study indicate that in GCA adult males outnumber females: 73% males, 20% females and 7% adults of unknown sex. MYCA, V is excluded from this estimate. In GCB the preponderance of males is repeated: 76% males to 24% females according to Angel; or 86% males to 14% females according to Little (Brown *et al.* 2000, 118), or 74% males to 15% females according to Triantaphyllou (Voutsaki *et al.* 2007).

On the evidence of dental development and attrition, and the degree of closure of the cranial sutures, the majority of the adult individuals seem to have died relatively young. With the exception of MYC1, III who died at the age of 35 to 40 years, seven (47%) individuals were less than 30 at the time of death, and three of them were not more than 25. Another seven (47%) were aged 30 to 35 years. Sub-adults are under-represented: one sub-adult and one infant. This need not reflect burial practices alone. Recovery techniques in the late

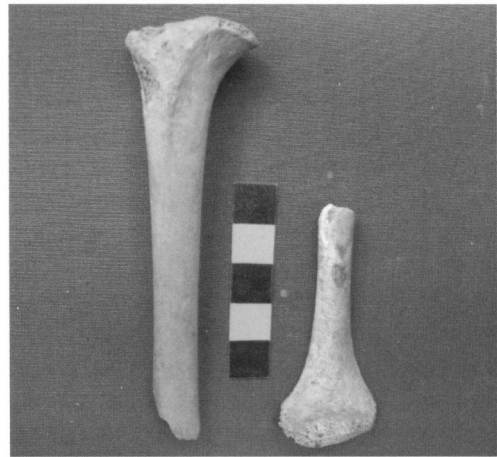


FIG. 31. Infant skeleton (MYCB, IV–V), Graves IV and V.

TABLE 28. Selected cranial non-metric traits: presence/absence.

Individual	Cranial non-metrics									
	Metopic suture	Lambdoid ossicles		Ossicle at lambda	Supra-orbital foramen complete		Frontal notch/foramen		Maxillary bridging	
		L	R		L	R	L	R	L	R
MYC1, III	0	—	—	—	—	1	—	0	1	—
MYC2, III	0	—	—	—	—	—	—	—	—	—
MYC3, III	0	—	—	—	—	0	—	1	—	—
MYC1, IV	0	—	—	0	0	—	1	—	—	—
MYC2, IV	0	—	0	0	—	0	—	1	—	0
MYC3, IV	—	—	—	—	—	0	—	1	—	—
MYC4, IV	0	—	—	—	—	—	—	—	—	—
MYC5, IV	—	1	—	0	—	—	—	—	—	—
MYC1, V	1	—	1	0	—	—	—	—	0	—
MYC2, V	0	—	—	—	1	—	0	—	0	—
MYC4, V	1	—	—	—	—	—	—	—	—	—
MYC1, VI	0	0	—	0	1	0	1	1	1	1
MYC2, VI	0	0	—	0	1	0	0	1	1	1
Frequency	2/11	1/3	1/2	0/6	3/4	1/6	2/4	5/6	3/5	2/4
Mycenae GCA,										
Frequency (%)	18	33	50	0	75	17	50	83	60	50

Key: L = left, R = right, 1 = presence, 0 = absence, — not recordable owing to missing or damage on the associated bone.

TABLE 29. Selected post-cranial non-metric traits: presence/absence.

Individual	Post-cranial non-metrics											
	Septal Aperture (humerus)		Poirier's facet (femur)		Plaque formation (femur)		Medial squatting facet (tibia)		Lateral squatting facet (tibia)		Medial talar facet (talus)	
	L	R	L	R	L	R	L	R	L	R	L	R
MYC1, III	0	—	—	—	—	—	—	0	—	1	—	—
MYC1, IV	—	—	0	0	1	1	—	—	—	—	—	—
MYC2, IV	0	0	—	0	—	1	—	—	—	1	0	—
MYC3, IV	—	0	—	—	—	—	—	—	—	—	—	—
MYC1, V	—	1	—	—	—	—	0	0	1	1	—	—
MYC2, V	1	—	—	1	—	—	—	—	—	—	—	—
MYC1, VI	1	—	—	—	—	—	—	—	1	1	—	—
MYC2, VI	0	—	—	—	1	—	0	—	1	1	—	—
Frequency	2/5	1/3	0/1	1/3	2/2	2/2	0/2	0/2	3/3	5/5	0/1	—
Frequency (%)	40	33	0	33	100	100	0	0	1	100	0	—

Key: L = left, R = right, 1 = presence, 0 = absence, — = not recordable owing to missing or damage on the associated bone.

TABLE 30. Selected dental non-metric traits, maxillary teeth: presence/absence.

Individual	Dental non-metrics, maxillary teeth											
	Shovelling I1		Shovelling I2		Canine mesial accessory ridge		Bushman canine		Carabelli's cusp		Parastyle	
	L	R	L	R	L	R	L	R	L	R	L	R
MYC1, III	0	0	—	0	—	—	—	—	—	—	—	—
MYC2, III	—	—	—	0	0	—	0	—	—	—	—	—
MYC1, IV	—	—	—	—	—	—	—	—	—	—	—	—
MYC2, IV	—	—	—	—	—	—	—	—	—	—	—	—
MYC3, IV	—	—	—	—	—	—	—	—	1	—	—	—
MYC1, V	0	—	1	—	1	—	—	—	1	—	1(M2)	1(M2)
MYC2, V	—	—	—	1	0	0	0	0	—	—	0	0
MYC1, VI	—	—	—	—	1	1	1	1	1	1	0	0
MYC2, VI	—	—	—	—	0	—	0	—	1	1	0	0
Frequency	0/2	0/1	1/1	1/3	2/5	1/2	1/4	1/2	4/4	2/2	1/4	1/4
Frequency (%)	0	0	100	33	40	50	25	50	100	100	25	25

Key: L = left, R = right, 1 = presence, 0 = absence, — = not recordable owing to missing or damage on the associated bone.

TABLE 31. Selected dental non-metric traits, mandibular teeth: presence/absence.

Individual	Dental non-metrics, mandibular teeth											
	Shovelling I1		Shovelling I2		Canine mesial accessory ridge		Bushman canine		Protostylid			
	L	R	L	R	L	R	L	R	L	R		
MYC2, III	—	—	—	—	—	—	—	—	—	—	—	—
MYC1, IV	—	—	0	—	0	0	0	0	0	0	0	0
MYC2, IV	—	0	—	0	—	—	—	—	—	—	—	—
MYC3, IV	—	—	—	—	—	—	—	—	—	—	—	—
MANDIBLE 4, IV	—	—	—	—	—	—	—	—	—	—	0	0
MYC1, V	—	—	—	—	—	—	—	—	0	0	0	0
MYC2, V	—	—	—	—	—	—	—	—	0	0	—	—
MYC2, VI	—	—	0	—	0	0	0	0	0	0	0	0
MYC1, VI	—	—	—	—	—	—	—	—	—	—	—	—
Frequency	—	0/1	0/2	0/1	0/3	0/2	0/3	0/2	0/5	0/5	0/5	0/5
Frequency (%)	—	0	0	0	0	0	0	0	0	0	0	0

Key: L = left, R = right, 1 = presence, 0 = absence, — = not recordable owing to missing or damage on the associated bone.

TABLE 32. Key to Fédération Dentaire Internationale tooth-side identification system. Each tooth—permanent and deciduous—is identified by two numbers. The first number indicates the quadrant it comes from; the second indicates the tooth. Thus 18 is the upper right permanent third molar; and 75 the lower left deciduous second molar. Further information on dental notation is easily available on many web sites.

Quadrants			Teeth		
Permanent	Quadrant	Upper/lower/side	Permanent	No.	Tooth
	1	Upper right		1	Central incisor
	2	Upper left		2	Lateral incisor
	3	Lower left		3	Canine
	4	Lower right		4	First premolar
Deciduous	Quadrant			5	Second premolar
		5		6	First molar
		6		7	Second molar
		7		8	Third molar ('wisdom tooth')
	8	Lower right			
			Deciduous	No.	Tooth
				1	Central incisor
				2	Lateral incisor
				3	Canine
				4	First molar
				5	Second molar

nineteenth century and the differential preservation of juvenile skeletons may also account for the small number of sub-adults in GCA. In GCB individuals aged 35+ are better represented: 48% (Angel) or 57% (Little) as opposed to 6% in GCA (see Brown *et al.* 2000, 118). To some extent the difference in the age-composition of the two skeletal collections may also reflect inter-observer error. Nevertheless the occupants of GCA do seem to have been comparatively young.

Even though they may have died relatively young, their skeletal remains offer no evidence of poor life conditions. On the contrary, their overall good dental health, and the size and robusticity of the skeletons from Graves IV and V in particular, suggest a diet rich in protein, probably marine protein too. That was the finding of Richards and Hedges (2007) when they analysed the stable nitrogen isotope ratios in bone collagen from nine GCA individuals.

Even though a sample of three is scarcely representative, the estimated living stature of MYC1, IV (1.70 m), MYC1, V (1.81 m), and MYC2, VI (1.65 m) is higher than that of their contemporaries at Lerna in the Argolid (1.62 m to 1.72 m, $n=5$) and Myrtos Pyrgos on Crete (1.63.5 m to 1.74 m, $n=5$)—all these data derive from Nafplioti's doctoral research. Some years ago Angel (1973, 386) made a similar observation when he contrasted the relatively high living stature of fourteen male individuals from GCA and GCB (mean = 1.72 m) with that of lower ranking contemporaries from Attica, Asine, Argos, Lerna, and Mycenae (mean = 1.66 m).

With the exception of the maxilla of MYC1, III and the Maxilla B, IV, dental attrition was mainly slight to moderate for all GCA adults. The incidence of caries was low; 10 out of the 148 (7%) teeth recorded had carious lesions. However, in one case (MYC2, IV), it was so

TABLE 33. Key to dental charts.

Symbol	Meaning
✓	tooth and socket present
[]	area of alveolar bone missing
A	abscessed socket
AM	socket healed or healing; tooth lost <i>ante mortem</i>
C	carious lesion present on tooth
CB	caries on buccal surface
CIP	caries on inter-proximal surface
CO	caries on occlusal surface
EH	enamel hypoplasia present
PM	socket present but tooth missing and lost <i>post mortem</i>
S	tooth represented only by a dentine root stump

severe that the crown was completely destroyed and an abscess drained though the mandibular body. Only four people, MYC₁, III, MYC₂, III, MYC₁, IV, and Maxilla A, IV, lost teeth before death. Alveolar resorption in MYC₁, IV and MYC₂, VI was associated with periodontitis, whereas it probably resulted from dental attrition in the case of MYC₁, III and Maxilla B, IV.

However, the high status of the GCA individuals did not completely isolate them from stress, whether pathogenic, nutritional, activity-related, or from other causes. Despite their overall good dental and skeletal health, hypoplastic lines were observed on the dentition of MYC₁, III, MYC₂, III, MYC₁, IV, MYC₁, V and MYC₂, VI, which probably reflect dietary, disease-related, or other types of stress during their early childhood. Moreover, hypertrophy of the diploë in the cranial walls of MYC₂, III, MYC₁, V and MYC₂, V should probably be associated with thalassaemia or iron deficiency anaemia. Anaemia may also have caused the

TABLE 34. Number of individuals in each grave derived from: (a) our examination of the human skeletal remains; (b) Stamatakis's on-site observations.

Grave	Number of Individuals	
	(a) Nafplioti and Musgrave	(b) Stamatakis's reports
I	No material available for examination	4
II	No material available for examination	2
III	3 adults (1 female, 1 male and 1 probable male), 1 sub-adult	3 adults, 1 infant
IV	5 adults (3 males, 2 probable females)	5
V	5 adults (4 males, 1 male/female), 1 sub-adult, 1 infant, plus the remains from the plaster-framed soil structure.	3
VI	2 adults (males), plus one additional left zygomatic	2
	Minimum Number of Individuals for GCA: 17	Minimum Number of Individuals for GCA: 20

cribra orbitalia in two (MYC₄, IV and MYC₂, VI) out of eleven individuals from GCA, where the lesion could be recorded. MYC₂, VI's suggested meningioma was probably asymptomatic.

Despite the presence of marginal osteophytes on the articular surfaces of two bones from MYC₂, IV, MYC₁, V, and MYC₂, VI and the formation of new bone on the right femoral head of MYC₂, V, osteoarthritis was only diagnosed on the right superior tibiofibular articulation of MYC₂, VI. The low incidence of osteoarthritis in this collection was not unexpected given the relatively young age at death of the majority of the individuals on the one hand, and the age-component of the multifactorial aetiology of osteoarthritis on the other (Rogers and Waldron 1995, 33).

Slight to prolific periostitis on the cranial or the post-cranial skeleton of MYC₂, IV, MYC₃, IV, MYC₄, V, MYC₂, VI, and on the additional right femur from Grave IV, point to a non-specific infection or direct trauma. With the exception of MYC₃, IV, these lesions probably reflect a past infection rather than one active at the time of death.

The incidence of fractures was very low. The only two recorded—a compression fracture of a lumbar vertebra and a probable stress fracture of the distal shaft of the right tibia—occurred on MYC₁, V. Both of them had healed before his death. Ankylosis of the joint between the right second metatarsal and the intermediate and medial cuneiforms of MYC₁, IV was probably congenital rather than post-traumatic.

Hypertrophy of muscle/tendon/ligament attachment sites points to engagement in strenuous physical activities and excessive mechanical loading of the respective muscles and skeletal elements. Different skeletal elements and/or regions showed different degrees of hypertrophy, ranging from slight to considerable. Considerable enthesophytosis was recorded on MYC₃, IV, MYC₁, V, MYC₄, V, and MYC₂, VI and was most marked on MYC₂, IV. The severity and frequency of these lesions on MYC₂, IV may be at least partly related to his predisposition to bone formation. It was further observed that the right side of his skeleton tended to be more severely affected than the left. Angel (1973, 386) also commented on the 'generally pronounced markings for muscle attachment sites' on the GCA and GCB skeletons and their 'greater strength'.

Finally, because of low sample size and the incompleteness of the skeletons, evidence of kinship could only be sought tentatively in the scanty non-metric morphological data available. Even so, it is interesting to note that patent metopic sutures and shovelling of upper second incisors only occurred in individuals from Grave V. Likewise, a septal aperture was only recorded on the humeri of MYC₁, V and MYC₂, V (and MYC₁, VI). This suggests that the occupants of Grave V may have been more closely related to each other than they were to the other GCA individuals. Perhaps the majority of them belonged to the same family. This interpretation should, however, be treated with caution for the reasons explained above.

National Archaeological Museum, Athens
Wiener Laboratory, ASCSA
Department of Anatomy, University of Bristol
The Manchester Museum, University of Manchester

LENA PAPAZOGLU-MANIOUDAKI
 ARGYRO NAFPLIOTI
 J.H. MUSGRAVE
 A.J.N.W. PRAG

BIBLIOGRAPHY

- Åkerström, Å. 1978. 'Mycenaean Problems II. Four Bronze Casings from Shaft Grave III at Mycenae', *OpAth* 12, 38–68.
- Angel, J.L. 1964. 'Osteoporosis: Thalassemia?', *American Journal of Physical Anthropology*, 22, 369–74.
- 1966. 'Porotic Hyperostosis, Anemias, Malaras and Marshes in the Prehistoric Eastern Mediterranean', *Science*, 153, 760–3.
- 1973. 'Human Skeletons from Grave Circles at Mycenae', in Mylonas, G.E. (ed), *Ὁ Ταφικὸς Κύκλος Β τῶν Μυκηναίων* (Library of the Archaeological Society at Athens, 73; Athens), 379–97.
- Aufderheide, A.C. and Rodríguez-Martín, C. 1998. *The Cambridge Encyclopedia of Human Paleopathology* (Cambridge).
- Berry, A.C. and Berry, R.J. 1967. 'Epigenetic variation in the human cranium', *Journal of Anatomy*, 101, 361–79.
- Bouwman, A.S., Brown, K.A., Prag, A.J.N.W., and Brown, T.A. 2008. 'Kinship between burials from Grave Circle B at Mycenae revealed by ancient DNA typing', *Journal of Archaeological Science*, 35, 2580–4.
- — Chilvers, E.R., and Prag, A.J.N.W. 2009. 'Kinship in Aegean prehistory? Ancient DNA in human bones from Greece and Crete', *BSA* 104, 293–309.
- Brooks, S. and Suchey, J.M. 1990. 'Skeletal age determination based on the os pubis: a comparison of the Acsadi–Nemeskeri and Suchey–Brooks methods', *Human Evolution*, 5, 227–38.
- Brothwell, D.R. 1981. *Digging Up Bones*, 3rd edn (London).
- Brown, T.A., Brown, K.A., Flaherty, C.F., Little, L.M. and Prag, A.J.N.W. 2000. 'DNA Human analysis of bones from Grave Circle B at Mycenae: a first report', *BSA* 95, 115–19.
- Buikstra, J.E. and Ubelaker, D.H. 1994. *Standards for Data Collection from Human Skeletal Remains* (Arkansas Archaeological Survey Report Number, 44: Fayetteville).
- Calder, W.M., III and Traill, D. 1986. *Myth, Scandal, and History: The Heinrich Schliemann Controversy and a First Edition of the Mycenaean Diary* (Detroit).
- Capasso, L., Kennedy, K.A.R., and Wilczak, C.A. 1999. *Atlas of Occupational Markers on Human Remains* (Journal of Paleontology, Monograph Publication, 3: Teramo).
- Cavvadias, P. 1894. *Les Musées d'Athènes: Musée National. Musée d'Acropole* (Athens).
- Chilvers, E.R., Bouwman, A.S., Brown, K.A., Arnott, R.G., Prag, A.J.N.W., and Brown, T.A. 2008. 'Ancient DNA in human bones from Neolithic and Bronze Age sites in Greece and Crete', *Journal of Archaeological Science*, 35, 2707–14.
- Corrucini, R.S. 1974. 'An examination of the meaning of cranial discrete traits for human skeletal biological studies', *American Journal of Physical Anthropology*, 40, 425–45.
- Czarnetzki, A. 1971. 'Epigenetische Skelettmerkmale im Populationsvergleich. I. Rechts-links-Unterschiede bilateral angelegter Merkmale', *Zeitschrift für Morphologie und Anthropologie*, 63, 238–54.
- Dahlberg, A.A. 1945. 'The changing dentition of man', *Journal of American Dentist Association*, 32, 676–90.
- Demakopoulou, K. 1990. 'Mycenae', in Demakopoulou, K. (ed), 88–105.

- (ed) 1990. *Troy, Mycenae, Tiryns, Orchomenos. Heinrich Schliemann: The 100th Anniversary of his Death* (Athens).
- 2002. “Εθνικό Αρχαιολογικό Μουσείο: Συλλογή Προϊστορικών”, *A Delt. Chr.* 52 (1997), 1–3.
- Dickinson, O.T.P.K (Oliver) 1977. *The Origins of Mycenaean Civilization* (SIMA 49; Göteborg).
- 2005. ‘The “face of Agamemnon”’, *Hesperia*, 74, 299–308.
- Finnegan, M. 1978. ‘Non-metric variation of the infracranial skeleton’, *Journal of Anatomy*, 125, 23–37.
- Hallgrímsson, B., Ó Donnabháin, B., Walters, G.B., Cooper, D.M.L., Guðbjartsson, D., and Stefánsson, K. 2004. ‘Composition of the founding population of Iceland: biological distance and morphological variation in early historic Atlantic Europe’, *American Journal of Physical Anthropology*, 124, 257–74.
- Hood, S. 1960. ‘Schliemann’s Mycenae Albums’, *Archaeology*, 13, 61–5.
- 1990. ‘Schliemann’s Mycenae Album’, in Demakopoulou 1990, 113–21.
- Howells, W.W. 1973. *Cranial Variation in Man: A Study by Multivariate Analysis of Patterns of Difference among Recent Human Populations* (Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University, 67; Cambridge, MA).
- Karo, G. 1930–3. *Die Schachtgräber von Mykenai* (Munich).
- Kelley, M.A. and Larsen, C.S. (eds), *Advances in Dental Anthropology* (New York).
- Kilian-Dirlmeier, I. 1986. ‘Beobachtungen zu den Schachtgräbern von Mykenai und zu den Schmuckbeigaben mykenischer Männergräber’, *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz*, 33. 1, 159–98.
- Krogman, W.M. and İscan, M.Y. 1986. *The Human Skeleton in Forensic Medicine* (Springfield, IL).
- Kullmann, L. and Wouters, H.W. 1972. ‘Neurofibromatosis, gigantism, and subperiosteal haematoma: report of two children with extensive subperiosteal bone formation’, *Journal of Bone and Joint Surgery*, 54, 130.
- Larsen, C.S. 1999. *Bioarchaeology: Interpreting Behavior from the Human Skeleton* (Cambridge).
- Ley, C.A., Aiello, L.C., and Molleson, T. 1994. ‘Cranial suture closure and its implications for age estimation’, *International Journal of Osteoarchaeology*, 4, 193–207.
- Long, Ch. 1974. *The Ayia Triada Sarcophagus: A Study of Late Minoan and Mycenaean Funerary Practices and Beliefs* (Göteborg).
- Lovejoy, C.O., Meindl, R.S., Pryzbeck, T.R., and Mensforth, R.P. 1985. ‘Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death’, *American Journal of Physical Anthropology*, 68, 1–14.
- Mann, R.W. and Hunt, D.R. 2005. *Photographic Regional Atlas of Bone Disease. A Guide to Pathologic and Normal Variation in the Human Skeleton* (Springfield, IL).
- and Murphy, S.P. 1990. *Regional Atlas of Bone Disease: A Guide to Pathologic and Normal Variation in the Human Skeleton* (Springfield, IL).
- Mays, S. 1998. *The Archaeology of Human Bones* (London).
- McKern, T. and Stewart, T.D. 1957. *Skeletal Age Changes in Young American Males, Analyzed from the Standpoint of Identification* (Technical Report EP-45. Massachusetts: Headquarters, Quartermaster Research and Development Command).
- Molnar, S. 1971. ‘Human Tooth Wear, Tooth Function and Cultural Variability’, *American Journal of Physical Anthropology*, 34, 175–90.
- Mylonas, G. 1966. *Mycenae and the Mycenaean Age* (Princeton).
- 1969. “Ο πέμπτος λακκοειδής τάφος του κύκλου Α των Μυκηνών”, *Arch. Eph.* 125–42.

- Nafplioti, A. 2007. 'Population bio-cultural history in the South Aegean during the Bronze Age' (unpublished PhD diss., University of Southampton).
- 2009. 'Mycenae Revisited part 2. Exploring the local vs. non-local origin of the individuals from Grave Circle A at Mycenae: evidence from strontium isotope ratio ($^{87}\text{Sr}/^{86}\text{Sr}$) analysis', *BSA* 104, 279–91.
- Ortner, D.J. 2003. *Identification of Pathological Conditions in Human Skeletal Remains*, 2nd edn (San Diego, CA).
- and Putschar, W.G.J. 1981. *Identification of Pathological Conditions in Human Skeletal Remains* (Smithsonian Contributions to Anthropology, 28; Washington, DC, and London).
- Ossenberg, N.S. 1970. 'The influence of artificial cranial deformation on discontinuous morphological traits', *American Journal of Physical Anthropology*, 33, 357–71.
- Papazoglou-Manioudaki, L. 1994. 'A Mycenaean warrior's tomb at Krini, near Patras', *BSA* 89, 171–200.
- 2003. 'Rhyta, figures and figurines in the shape of bulls in prehistoric Greece', in Athanassopoulou, S. and Tzedakis, Y. (eds), *The Bull in the Mediterranean World: Myth and Cults* (Athens), 118–23.
- Nafplioti, A., Musgrave, J.H., Neave, R.A.H., Smith, D., and Prag, A.J.N.W. 2009. 'Mycenae Revisited: The Human Remains from Grave Circle A. Part 1. Stamatakis, Schliemann and Two New Faces from Shaft Grave VI', *BSA* 104, 233–77.
- Perizonius, W.R.K. 1984. 'Closing and Non-Closing Sutures in 256 Crania of Known Age and Sex from Amsterdam (A.D. 1883–1909)', *Journal of Human Evolution*, 13, 201–6.
- Philadelphus, A. 1935. *The Museum of Athens* (Athens).
- Prag, A.J.N.W. (John) and Neave, R.A.H. (Richard) 1997. *Making Faces Using Archaeological and Forensic Evidence* (London; repr. with corrections 1999).
- Musgrave, J.H., Neave, R.A.H., and Thimme, D.I. 1995. 'Seven faces from Grave Circle B at Mycenae', *BSA* 90, 107–36.
- Resnick, D. 2002. *Diagnosis of Bone and Joint Disorders*, 4th edn. (Philadelphia).
- Richards, M.P. and Hedges, R.E.M. 2007. 'Stable isotope evidence of past human diet at the sites of the Neolithic cave of Gerani; the Late Minoan III cemetery of Armenoi; Grave Circles A and B at the Palace of Mycenae; and Late Helladic Chamber tombs', in Tzedakis, Y., Martlew, H., and Jones, M. (eds), *Archaeology Meets Science: Biomolecular Investigations in Bronze Age Greece. The Primary Scientific Evidence, 1997–2003* (Oxford), 220–30.
- Rogers, J. and Waldron, T. 1995. *A Field Guide to Joint Disease in Archaeology* (Chichester).
- Rucknagel, D.L. 1966. 'On the Geographical Distribution and Ethnic Origin of Thalassaemia', *New Zealand Medical Journal*, 65, 825–32.
- Sakellariou, A. 1974. 'Un cratère d'argent avec scène de bataille provenant de la IV^e tombe de l'acropole de Mycènes', *AK* 17, 3–20.
- Saunders, S.R. 1989. 'Nonmetric skeletal variation', in İşcan, M.Y. and Kennedy, K.A.R. (eds), *Reconstruction of Life from the Skeleton* (New York), 95–108.
- Scheuer, L. and Black, S. 2000. *Developmental Juvenile Osteology* (London).
- Schliemann, H. 1880. *Mycenae: A Narrative of Researches and Discoveries at Mycenae and Tiryns* (New York).
- 1882. *Catalogue des trésors de Mycènes au Musée d'Athènes* (Leipzig).
- Smith, B.H. 1991. 'Standards of human bone formation and dental age assessment', in Kelley and Larsen (eds), 143–68.

- Stais, V. 1909/1915. *Collection mycénienne du Musée National* (Athens).
- 1926. *Mycenaean Collection of the National Museum* (Athens).
- Stuart-Macadam, P.L. 1989. 'Porotic Hyperostosis: relationship between orbital and vault lesions', *American Journal of Physical Anthropology*, 80, 187–93.
- Traill, D. 1995. *Schliemann of Troy: Treasure and Deceit* (London).
- Trotter, M. 1970. 'Estimation of stature from intact long bones', in Stewart, T.D. (ed), *Personal Identification in Mass Disasters* (Washington), 71–83.
- Tsountas, Chr. and Manatt, J. 1897. *The Mycenaean Age* (Boston).
- Turner, C., Nichol, C., and Scott, G. 1991. 'Scoring procedures for key morphological traits for the permanent dentition: the Arizona State University Dental Anthropology System', in Kelley and Larsen (eds), 13–31.
- Tyrell, A.J. and Chamberlain, A.T. 1988. 'Non-metric trait evidence for modern human affinities and the distinctiveness of Neanderthals', *Journal of Human Evolution*, 34, 549–54.
- Ubelaker, D.H. 1989. *Human Skeletal Remains* (Washington).
- 1992. 'Porotic hyperostosis in prehistoric Ecuador', in Stuart-Macadam, P. and Kent, S. (eds), *Diet, Demography, and Disease* (New York), 201–17.
- Voutsaki, S., Triantaphyllou, S., Ingvarsson-Sundström, A., and Milka, E. 2007. 'Project on the Middle Helladic Argolid: a report on the 2006 season', *Pharos*, 14, 59–99.
- Waldron, T. 2009. *Palaeopathology* (Cambridge).
- White, T.D. and Folkens, P.A. 2000. *Human Osteology*, 2nd edn (San Diego).