

# The lameness of King Philip II and Royal Tomb I at Vergina, Macedonia

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**King Philip II was the father of Alexander the Great. He suffered a notorious penetrating wound by a lance through his leg that was nearly fatal and left him lame in 339 B.C.E. (i.e., 3 y before his assassination in 336 B.C.E.). In 1977 and 1978 two male skeletons were excavated in the Royal Tombs II and I of Vergina, Greece, respectively. Tomb I also contained another adult (likely a female) and a newborn skeleton. The current view is that Philip II was buried in Tomb II. However, the male skeleton of Tomb II bears no lesions to his legs that would indicate lameness. We investigated the skeletal material of Tomb I with modern forensic techniques. The male individual in Tomb I displays a conspicuous case of knee ankylosis that is conclusive evidence of lameness. Right through the overgrowth of the knee, there is a hole. There are no obvious signs that are characteristic of infection and osteomyelitis. This evidence indicates that the injury was likely caused by a severe penetrating wound to the knee, which resulted in an active inflammatory process that stopped years before death. Standard anthropological age-estimation techniques based on dry bone, epiphyseal lines, and tooth analysis gave very wide age ranges for the male, centered around 45 y. The female would be around 18-y-old and the infant would be a newborn. It is concluded that King Philip II, his wife Cleopatra, and their newborn child are the occupants of Tomb I.**

Argead dynasty | Macedonia | paleopathology | Philip II | Vergina

**T**he Great Tumulus in Vergina contains three Royal Tombs (I, II, and III) and one “*Heroon*” (shrine dedicated to a hero) next to Tomb I. Tomb I was built with the same big porous ashlar blocks as the *Heroon*, for which there is unanimous agreement by scholars that it belongs to Philip II (from now on called Philip) (1). There is also unanimous agreement that Tomb III, which has a façade strikingly similar to that of Tomb II (with nine bluish triglyphs each), belongs to Alexander the Great’s son, Alexander IV (1). Tomb I is a cist tomb dated earlier than Tomb II (2, 3). Tomb I contains stunning wall paintings in its interior, the most important of which depicts “The rape of Persephone,” after which Tomb I was named. It also contained the bones of a male, a female, and a newborn (4). The Royal Tomb II was discovered unlooted in 1977, containing a rich array of grave goods, such as two golden larnakes (each with cremated human remains inside) and an armor consisting of items such as a cuirass, a helmet, and a shield. It was named “The Tomb of Philip,” which is a misnomer as we show here. Despite anthropological and archaeological evidence that the tomb belongs to King Arrhidaeus and his wife Eurydice (3, 5), the archaeological establishment still maintains that Tomb II belongs to Philip II (2, 6).

Tomb I contained the inhumed, unburnt, and incomplete remains of a man, a woman, and a full-term fetus or neonate (4, 7); they were the result of inhumation, not cremation (8). We aimed to study the lesions and estimate the ages of the three individuals in Tomb I and then compare them with those known from the ancient literary sources to identify the occupant of Royal Tomb I in Vergina. Most of the bones of these individuals have never

been presented before. Only a brief mention was made of few of them in a couple of lines (4, 7), and certainly nothing was reported on their lesions.

## Methods

We have established the presence of three individuals: two adults (Individuals 1 and 2) and one newborn (Individual 3). The bones were partially covered by a reddish-brown sediment. This sediment is mentioned as covering Tomb I and having been deposited into it as well, after the tomb was plundered (9) (*SI Appendix, Text S1*). The bones were found at the bottom of the talus cone a couple of meters thick that was formed after a hole in the roof of the Tomb was opened in ancient times after a horizontal tunnel was dug from the *Heroon* (1). The bones were touching the floor or were very close to it (*SI Appendix, Text S1*), indicating that they belong to the original occupants of the Tomb.

The presence of two adult individuals, i.e., a middle-aged adult male and a young female, is deduced from the occurrence of duplicate elements (*SI Appendix, Text S1*) in the collection: there are two adult maxillae (Fig. 1), two partial cranial bases, two left zygomatic bones, two left femora, and two left tibiae. From here on we will refer to the older adult individual as Individual 1 and the younger adult individual will be named Individual 2. For a detailed sorting of the adult bone collection, please refer to *SI Appendix*.

We assessed age and sex through direct analysis of the human remains and from CT images. We established age from the auricular surface of the ilium, os pubis, presence of epiphyseal lines, and tooth attrition. We assessed sexually dimorphic features of the pelvic bones and cranial bones.

The bones of interest were scanned with a 16-slice scanner (Siemens) and radiographed after they were examined with a magnifying glass. Macro-photography was used when necessary. Selected bones were also scanned using a surface scanner (Nextengine).

## Significance

**The knee ankylosis and the hole through it ties perfectly with the penetrating wound and lameness suffered by Philip II and conclusively identifies him as the occupant of Tomb I in Vergina, Greece. The age estimates of the three occupants are consistent with those derived from the historical sources. Cleopatra’s (Philip’s wife) child was born a few days before Philip II’s assassination and both were murdered soon after Philip’s assassination. It follows that Tomb II belongs to King Arrhidaeus and his wife Eurydice and may well contain some of the armor of Alexander the Great. Thus, a nearly 40-y-old mystery concerning the Royal Tombs of Vergina has finally been solved that puzzled historians, archaeologists, and physical anthropologists.**

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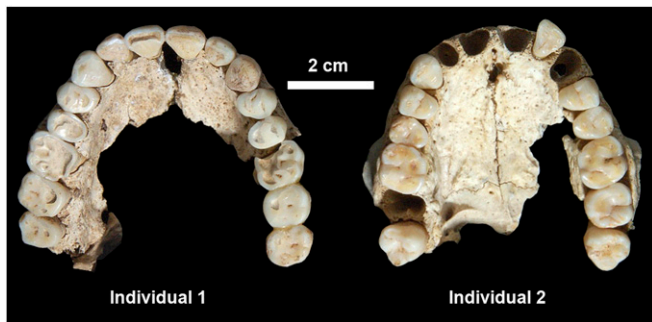


Fig. 1. The two maxillae from the Tomb I at Vergina. Individual 1 is a middle-aged male adult and Individual 2 is a young female adult.

## Results

**Individual 1.** Individual 1 is a middle-aged male represented by cranial fragments, the almost complete maxillae and mandible, parts of the vertebral column, thorax, and pelvis, and left leg (*SI Appendix, Text S2*). Sex assessment is based on the pelvic and mandibular morphology (Fig. 2).

An age-at-death in the fifth decade has been estimated based on the dental attrition (*SI Appendix, Text S2.3*). The age ranges produced in this way are very wide, but they center around 45 y and are consistent with that of a middle-aged man produced by the symphyseal and auricular surfaces of the pelvic bones (Fig. 3). This finding goes against Musgrave's (7) estimate of 25–35 y based exclusively on dental attrition and using a different comparative population from that used here (10).

Individual 1's stature has been calculated at around 180 cm (*SI Appendix, Table S1*). With such a great stature this male would be substantially taller than Individual 2 from Tomb I, and the average of various ethnic groups in Greece through time, and would be among the tallest of ancient Macedonians (11–13).

Individual 1 shows a remarkable flexional ankylosis of the left knee, which resulted in the fusion of the tibia with the femur (Fig. 4). Measurements taken on a virtual image obtained through the CT scanning show that the flexional ankylosis is 79°. This finding is accompanied by an external rotation of the tibia (*SI Appendix, Fig. S6*) that would have resulted in *coxa retroversa* with a waddling toeing-out gait. Apart from ankylosis, there is no great deformity of femur or tibia: only the supracondylar lines of the femur have disappeared because of remodeling that has taken place providing the distal femur with a rounded surface. The overgrowth of the fusion is eroded superficially in many places: both the patella and the proximal fibula were also likely fused antemortem but broke off postmortem.

Ankylosis may be the result of an active inflammatory process after a trauma or an infection, or congenital factors causing traumatic or septic arthritis or myositis ossificans (14). Here, the surface of the overgrowth is smooth, with no evidence of periostitis, osteolysis, cloaca, abscess, sequestration, or scarred sinus track anywhere on the fused femur or tibia that are characteristic of pyogenic or tuberculous infection and osteomyelitis. This finding indicates that the active inflammatory process stopped years before death. If there was an infection, this was resolved long before the time of death. Because such bony synostoses with no obvious signs of infection are commonly produced by severe injuries (15, 16), we deduce that the ankylosis was caused by a severe wound to the knee. This would have affected locomotion and rendered the person lame, with an uneven gait.

Right through the overgrowth of the knee, there is a hole (Fig. 4). Sometimes such holes appear in cases of knee ankylosis as they are formed by the intercondylar fossa of the femur and the tibial plateau. However, here the hole is below the level of the femoral condyles (Fig. 4). In addition, the distance between the distal femur

and the proximal tibia is 2.8 cm, at least four-times greater than in a living person. This finding is contrary to what one would expect, as in ankylosis cases there is usually a narrowing of the joint space (16–19). This finding implies that the two bones were dislocated from each other. Thus, the ankylosis was caused by a severe wound to the knee, likely affected by a penetrating instrument, such as a fast-moving projectile (like a spear) that could be responsible for the hole in the overgrowth separating the two bones from each other. Apparently, the penetrating instrument was removed after the overgrowth had started to form.

There is an asymmetry in shape and lesion between the right and left occipital condyles of the male individual (Fig. 5) and in the C3 (*SI Appendix, Fig. S9*). Along the posterior margin of the right occipital condyle, there are marginal osteophytes (new bone formation) and along its lateral side there is extensive pitting and porous lipping. On the upper left articular facet of C3 there is also a marginal osteophyte (lipping). These lesions are likely to reflect osteoarthritis. The asymmetries point to chronic punctuated torticollis (laterocollis) or wryneck. Apparently, the lameness of this individual caused a compensatory tilting of the head to the right every time he was stepping on the left leg, effecting these asymmetries. Indeed, torticollis and osteoarthritis are some of the effects of lameness (20–22).

**Individual 2.** Individual 2 is a young adult female that is represented in the collection by parts of the cranium and elements of the upper and lower limbs. Sex assessment is based on cranial features. Based on the degree of dental wear and the presence of femoral and humeral epiphyseal lines, Individual 2 would be around 18-y-old at the time of death (*SI Appendix, Text S3*).

Individual 2's stature has been calculated based on her left femur to be around 165 cm. Although Musgrave (7) wrongly assigned these femora to Individual 1, we agree with Musgrave's observation that the individual was well built (robust) based on the large size of the femoral head.

**Individual 3.** Individual 3 (*SI Appendix, Text S4*) preserves part of the cranium, axial skeleton, upper limb, and pelvis. The age-at-death determination of long bones after correction for shrinkage yields an age-at-death from around 41–44 wk, which makes the infant here a newborn, assuming the neonatal peak is between 38 and 40 wk (23). This finding is in agreement with the statements of Andronikos (4) that in Tomb I a newborn was found and that



Fig. 2. Maxilla and mandible from Individual 1.



Fig. 3. Ventral (right) and symphyseal (left) views of the left pubic bone attributed to Individual 1.

“the young woman must have died with her baby, almost immediately after the birth” (2). The finding is also close to that presented by Musgrave (7), who did not take into account the bone shrinkage: “full-term fetus or neonate (of 38–39 intra-uterine weeks by modern standards).”

Some authors have observed sexual dimorphism in juvenile skeletal samples of known sex (24, 25), whereas other authors suggest that the application of this method to archaeological and forensic skeletal material may be problematic (26). Thus, given

the uncertainty of the results, no sex determination attempts have been made to this individual. Future genetic analyses should provide data on the sex and kinship of this individual.

### Discussion

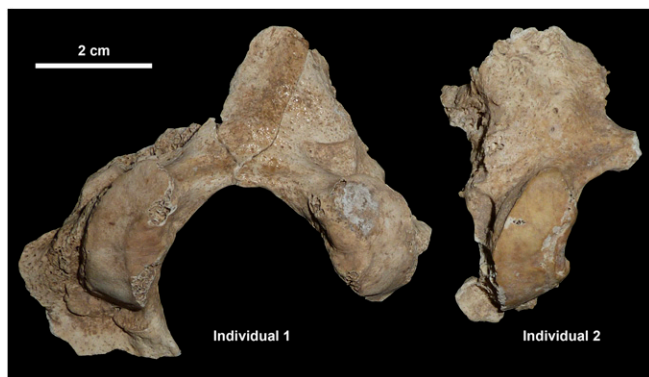
One of the reasons Andronikos (4) suggested that Philip was buried in Tomb II rests on the flower passage made by the Latin author Justin (11.1.4) that Philip was cremated. However, this is because Justin was used to the Roman practices, where Roman emperors were cremated. Thus, Justin’s statement is false (3) and there is no earlier literary evidence from the sources to justify such a suggestion. This approach is against a previous speculation (27) that Philip’s status would have required cremation, not inhumation.

There are several ancient literary sources that describe the famous wound that was nearly fatal and left Philip lame. The wound occurred in 339 B.C.E. (i.e., 3 y before Philip’s death) (28). Combining Justin, Demosthenes, Plutarch, and Athenaeus with recent scholarship, we have the following story:

As Philip was returning to Macedonia from the Scythian campaign against Ateas, the Thracian tribe of Triballoi met him and refused to allow him passage unless they received a share of the spoils. Hence, a dispute arose and afterward a battle, in which Philip received so severe a wound through his leg by a lance that his horse was killed by it; and because it was generally supposed that Philip was dead, the booty was lost. However, as soon as Philip recovered from his wound, he made war upon the Athenians.



Fig. 4. Lateral view of the left leg of Individual 1 in flexion showing the massive knee ankylosis. The distal femur and the proximal tibia are fused together. The whole structure was found broken in two pieces that perfectly refit together: the upper part, which is mainly the left femur, and the lower part, which is mainly the outgrowth with the tibia. The two pieces are shown separately from one another in posterior view. The lateral views show the ankylosis in 79° of flexion. In the radiograph, note also the sediment that has filled the medullary cavity. The distance between the femur and tibia is 2.8 cm (i.e., by far greater than that in the normal bones). This means that the two bones were dislocated from each other. Note also the hole likely produced by a penetrating impact (upper right corner) and the radiograph of the knee ankylosis in anteroposterior view showing the hole below the level of the femoral condyles.



**Fig. 5.** The two partial cranial bases found in Tomb I, the male (left) and the female (right). Note the marginal osteophytes caused by osteoarthritic remodeling in the right occipital condyle of the male that could be because of the postural consequences of the lameness.

Therefore, Philip's lameness is conclusive evidence for the identification of one tomb occupant as Philip (4). Because the knee ankylosis and the hole within it described above are conclusive evidence of lameness and tie perfectly with the historical evidence of the spear that went through Philip's leg, it follows that Individual 1 identifies Tomb I as belonging to Philip. Thus, the knee ankylosis is the hallmark of Tomb I identification.

If Philip suffered from an infection associated with the wound, it could have been resolved long before his death, as is the case of Individual 1 in Tomb I. Again, the paleopathological evidence is in full agreement with the literary sources. Thus, one may deduce that Philip's leg was not infected, or if infected it was soon healed. There is uncertainty in the sources as to the side and exact location of Philip's injury: Seneca points to the lower leg (tibia?), Justin and Plutarch to the femur, and Demosthenes and Athenaeus to the leg (28). Only Didymus reports that one of the men thrust his lance into Philip's right femur, laming him (28, 29). However, we chose only the word "leg" in the above story not only because all ancient writers agreed on that but also because Demosthenes is the only one who lived during Philip's time, and he used just the word "leg" without specifying which one, whereas Didymus lived much later than Philip, in the late first century B.C.E. and early first century C.E., and his works were often contradictory. Thus, Didymus relied on earlier scholars who, as we know, gave no clue as to which leg was affected. Didymus was hardly without fault, as the mention of "sarissa" instead of "lance" that went through Philip's leg shows (28), because a sarissa is a Macedonian weapon and would not have been used by the Triballoi. That is why there was so much doubt already in antiquity (i.e., Plutarch's *Moralia* 739b) as to which leg of Philip was wounded (28).

Apart from the knee ankylosis, the ages-at-death of the three individuals confirm the identification of Tomb I as belonging to Philip, his wife Cleopatra, and their newborn child. Most scholars estimate that Philip was 46- (3, 30) or 47-y-old (31) when he was assassinated in 336 B.C.E. Arrhidaeus was around 39 y when he was murdered (32), some 7 y younger than Philip at the time of his death. Thus, the age-at-death of the male individual in Tomb I is more consistent with that of Philip. Cleopatra was a maiden

(παρθένος κόρη) when she married Philip [Plutarch (Alex. 9.6)] in 337 B.C.E. and likely in her late teens when she died in 336 B.C.E., as estimated by historians (3, 32, 33). This finding is consistent with the skeletal age of the female of Tomb I, estimated at around 18 y (*SI Appendix, Text S3.3*). In contrast, the female in Tomb II is about 25-y-old, with no bone features that would allow any estimate as low as 18–20 y (27, 34). Thus, the age-at-death of the Individual 2 from Tomb I matches the age-at-death of Cleopatra derived from historical sources (35), rather than the female individual from Tomb II (27).

The age-at-death of the Individual 3, estimated here at between 41.3 and 44.3 "intrauterine" weeks, makes it a neonate. What we know from the literary sources is that Cleopatra's baby was born a few days before Philip's assassination, according to Diodorus 17.2.3 (1). Olympias murdered Cleopatra and her baby immediately after Philip's assassination and Alexander's election as a new king (1, 36–38). Justin (9.7.12) wrote that a few days after Philip's death, Olympias burnt the body of the assassin Pausanias and then forced Cleopatra to hang herself, having first killed her daughter in her lap. Therefore, Justin implies that Cleopatra and her child were murdered soon after her husband Philip's assassination. Thus, the baby's skeleton in Tomb I confirms that the female occupant had died soon after childbirth (39). This evidence is against previous speculation that Cleopatra was executed a few months after Philip's assassination (7, 27). Because Eurydice did not have any children, we conclude that the newborn in Tomb I is Cleopatra's child, because there are no neonate bones found in Tomb II (27) and no historical record of another royal child killed as young as this in Macedonia. Cleopatra was the only Queen with a newborn: for example, she cannot be Nikesipolis, as suggested by Kottaridi (2), because Nikesipolis's daughter died at a much older age. Finally, there is a lot of confusion in the ancient sources contaminated by propaganda regarding the sex of Cleopatra's child. The only agreement is that Cleopatra bore only one child. Thus, the sex of the newborn has not been determined by osteological means and cannot be known from the literary sources either.

Thus, the most conclusive evidence as to the identification of Tomb I are the knee ankylosis with the hole, likely produced by a penetrating impact of the male individual, and the ages-at-death of the three individuals found in Tomb I. These data, taken together, make the case even stronger that Philip II, his wife Cleopatra, and their newborn child are the occupants of Tomb I, overturning the current opinion of the archaeological establishment that Tomb II belongs to Philip II. As a consequence, Tomb II could only belong to King Arrhidaeus and Eurydice and may well contain some of the armor of Alexander the Great (5, 37). The recovery of Philip II after this terrible wound in the knee joint is a remarkable event in an era without antibiotics. It demonstrates remarkable skill by his doctors to avoid bleeding.

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