Human remains from the Pigi Artemidos LBA tumulus, region of Macedonian Olympus, Pieria

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ABSTRACT

The paper concerns the contextual analysis of human remains from the Late Bronze Age tumulus cemetery of Pigi Artemidos, sited at the southeast border of the region of Macedonian Olympus. It presents the available body of evidence from this funerary assemblage and compares it to other LBA cemeteries from the same region. Bearing in mind the limitations imposed by the small sample size and the absence of a demographic profile for adults, infectious diseases (e.g. posttraumatic osteomyelitis), skeletal trauma and markers of occupational activity show that the few individuals buried in the tumulus of Pigi Artemidos were physically active; furthermore, stress and deprivation during growth and development suggest poor environmental conditions. A differential burial treatment is inferred between adults and subadults. At this early stage of the contextual analysis of prehistoric populations from the region of Macedonian Olympus in Pieria, the inter-cemetery variations reveal locally diverse lifestyles and funerary expressions at the dawn of the LBA.

INTRODUCTION

During the last decades, intense archaeological investigation in the region of Macedonian Olympus has revealed an important network of sites spanning from the Neolithic period to the Byzantine era.[1] This evidence changed considerably the archaeological map of mainland Greece and coastal Macedonia[2] and has revealed the diachronic occupation of the region from prehistoric to Early Modern times. The Bronze Age funerary assemblages that have been unearthed in southern Pieria[3] are of key interest for the following reasons: first, they were situated on or along important communication routes that link Macedonia with areas further to the north and south, such as the mountain pass of Petra on Mount Olympus (Ayios Dimitrios-Spathes) or the coastal areas of southern Pieria (Platamon) (Fig. 1); and second, they reveal a chronological sequence from the Middle Bronze Age/Late Bronze Age (MBA/LBA) transition throughout the whole LBA. Through the integrated analysis[4] of human skeletal remains from these sites, our aim is to examine the interplay between humans and their natural and cultural environments, as well as to discern regional and temporal variations of mortuary practices and cemetery landscapes throughout the 2nd millennium BC.

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[1] Koulidou *et al*. (forthcoming a, b); Koulidou 2014, 2015; Poulaki-Pantermali 2013.
[2] Andreou 2014.
[3] In particular the sites of Valtos Leptokaryas, Pigi Athinas, Pigi Artemidos, Rema Xydias and Trimbina 2&4.
[4] The biogeochemical analysis of human and animal samples from the aforementioned sites is in progress.

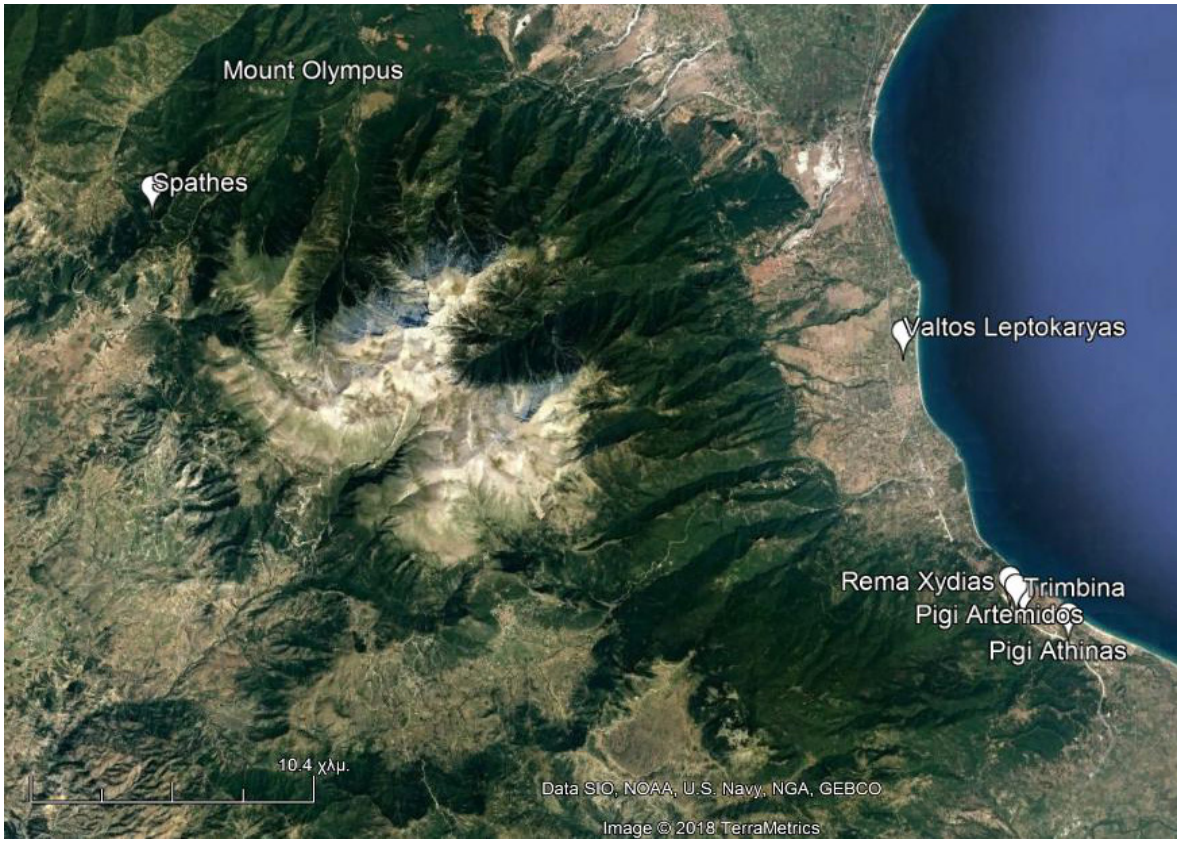

Fig. 1. Map of the region of Macedonian Olympus (southern Pieria) showing the location of the cemeteries discussed in the paper (map modified by P. Tritsaroli).

This paper combines skeletal and archaeological data in order to gain insight into the biological and mortuary profile of the Pigi Artemidos LBA assemblage. Bearing in mind the constraints imposed by the small sample size, the aim of this contextual approach is first to present the available body of evidence from Pigi Artemidos and then compare it to that of the tumuli cemeteries of Pigi Athinas,[5] Valtos Leptokaryas[6] (hereinafter Valtos) and the cemetery of Spathes from the same region. This analysis sheds more light on the biological identity of prehistoric societies of northern Greece and adds further to the contextual investigation of burial practices in the prehistoric Aegean.

MATERIAL

Pigi Artemidos was excavated in 2009 by the Ephorate of Antiquities of Pieria (Hellenic Ministry of Culture and Sports). The site was located close to the contemporary village of Platamon, occupied a surface of 1000m^2 and included two main phases of occupation: the Late Bronze Age and the Classical period. During LBA, the site was first used as a cemetery and then as a habitation area.[7]

The excavation revealed eleven funerary contexts comprising of ten graves and one deposit of bones. Nine of these graves and the deposit of bones were included in a tumulus delimited by a stone ring of 10m of diameter (Fig. 2) (Table 1). One grave (Gr 3) was not part of the tumulus and it has not been possible to date it; this grave is not discussed in the study. Six graves were simple pits and three were stone-lined pits (Grs 2, 4 and 10). Two graves were marked

[5] Tritsaroli 2017.
[6] Tritsaroli 2010.
[7] Koulidou 2014, 143, 146.

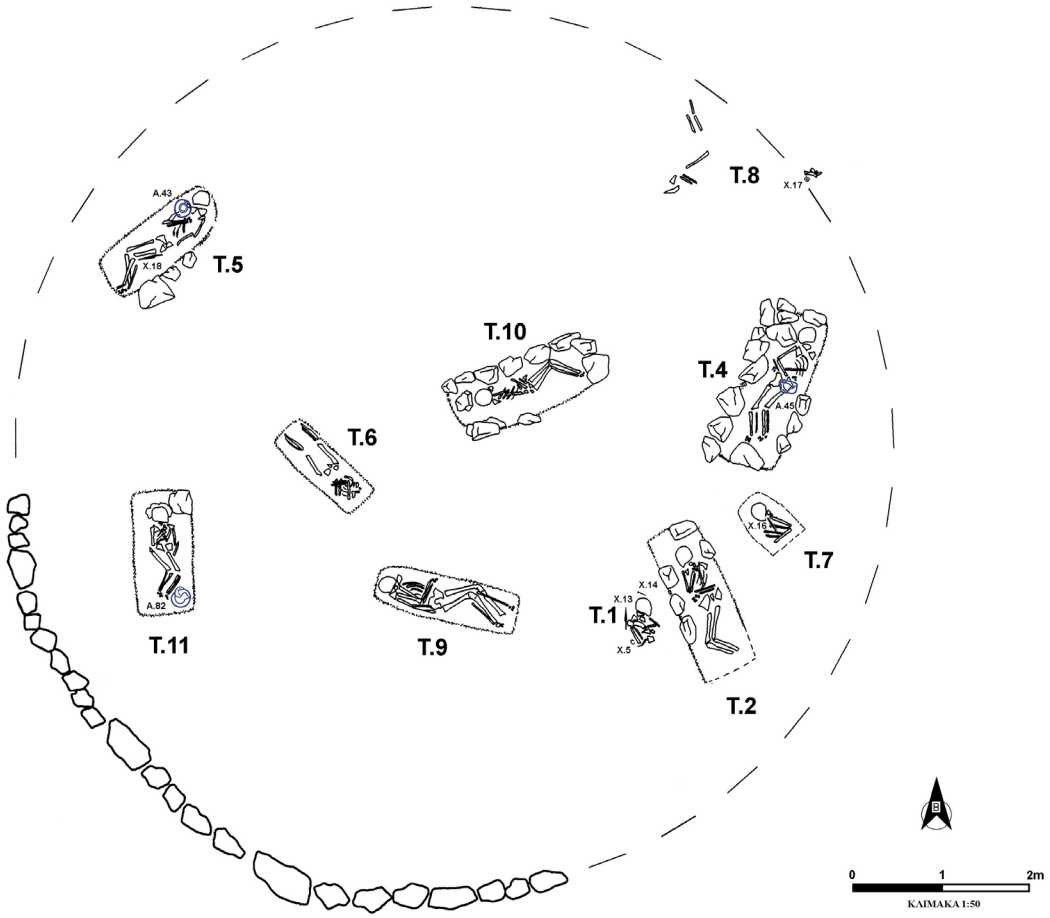

Fig. 2. Plan of the Pigi Artemidos tumulus (after Koulidou 2014, 145, fig. 2).

with a stone marker on top of their pits (Grs 9 and 10). The burial ground seems to have had an organized layout: a stone-lined pit grave with a stone marker was at the center of the tumulus, while the other graves were placed around the central one. The deposit of bones has conventionally been called Gr 8, but no particular construction has been identified during the excavation. Five of the nine graves were furnished; the few offerings deposited with the dead consisted mainly of clay vessels and bronze personal items (one bracelet, one spiral earring, two pins, and three knives). The pottery includes a vase of Mycenaean type, which dates the cemetery to the dawn of the LBA (1600–1400 BCE) (the ceramic phases between Late Helladic I to Late Helladic IIB).[8] The tumulus of Pigi Artemidos slightly postdates those of Valtos (1930–1505 BCE) and Pigi Athinas (1620–1500 BCE) and it predates the cemeteries of Spathes (1400–1200 BCE), Trimbina 2&4 (1400–1150 BCE) and Rema Xydias (1390–1200 BCE) in the same region.

The graves were variously oriented and all of them contained individual primary burials. The bodies were in a flexed position, lying on either their left or right sides; only in one case was the deceased placed on its back (Gr 6). The deposit of bones (Gr 8) included a few remains, belonging to an adult (see below the section on funerary treatment).

Bone completeness for the sample of Pigi Artemidos was moderate to poor (<25%). In addition, bones were very fragile and an important degree of fragmentation was observed which mostly occurred inside the graves, but also during recovery. Finally, bone surface preservation was poor (Grade 3 to 5),[9] representing important weathering and some incrustation. Bad preservation considerably hindered skeletal analysis and interpretation.

[8] Koulidou 2014, n. 14.

[9] Brickley and McKinley 2004, 16.

TABLE 1. LIST OF GRAVES AND HUMAN REMAINS

Grave	Grave architecture	Orientation	Burial offerings*	Age classes	Sex	Skeletal position
1	pit	N-S	wheel made pottery (squat jug), a bronze bracelet, a bronze pin and a bronze knife	infant	–	only the upper part of the skeleton preserved, left flexed ?
2	pit	N/NW-S/SE	none	young	male	right flexed
4	stone-lined pit	N/NE-S/SW	handmade pottery	adult	unknown	right flexed
5	pit	NE-SW	handmade pottery and one bronze knife	adult	unknown	right flexed
6	pit	SE-NW	none	adult	unknown	supine
7	pit	N/NW-S/SE	one bronze knife	adult	unknown	only the upper part of the skeleton preserved, right flexed ?
8 (deposit of bones)	–	–	bronze spiral earring	adult	unknown	unknown
9	stone-lined pit with stone marker	W-E	none	middle-aged	male	left flexed
10	stone-lined pit with stone marker	SW-NE	none	adult	unknown	left flexed
11	pit	N-S	handmade vessel and a bronze pin	child	–	left flexed

* The archaeological information on burial offerings is drawn from Koulidou (2014).

METHODS

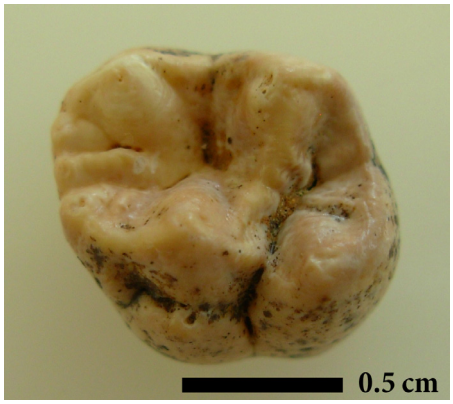

Fig. 3. Carabelli's trait on a permanent molar (infant from Gr 1).

Human skeletal remains were examined using macroscopic observation and radiography. Age estimation for subadults was based on standards for dental eruption and development,[10] measurement of long-bone length[11] and fusion of skeletal elements.[12] The age-at-death for adults was estimated from morphological changes to the pubic symphysis and the auricular surface of the *os coxae*.[13] Based upon the overall estimation of available data, each individual was assigned to one of the following age classes: fetal (i.e. <birth), infants (i.e. birth–3 years), children (i.e. 3–12 years), adolescents (i.e. 12–20 years), young adults (i.e. 20–35 years), middle-aged adults (i.e. 35–50 years) and old-aged adults (i.e. 50+ years).[14] Sex determination for adults was carried out using dimorphic aspects of the pelvis.[15] No stature calculations were attempted, due to the absence of complete long bones.

Skeletal examination of pathological lesions used standard data collecting methods for complete skeletons.[16] The following lesions were recorded: cribra orbitalia, porotic hyperostosis (frontals, parietals, occipitals), abnormal porosity and new bone formation on the cranial vault for the identification of anemia;[17] linear enamel hypoplasia (LEH) as reflective of developmental stress associated with infectious disease, malnutrition, or other kinds of relatively

[10] Ubelaker 1989.
[11] Maresh 1970.
[12] Scheuer and Black 2000.
[13] Brooks and Suchey 1990; Meindl and Lovejoy 1989; Todd 1920, 1921.
[14] Buikstra and Ubelaker 1994.
[15] Milner 1992; Phenice 1969.
[16] Buikstra and Ubelaker 1994.
[17] Lewis 2004; Stuart-Macadam 1985; Ortner *et al*. 1999, 2001.

TABLE 2. DENTAL DISEASES

Condition	N	n	Maxilla	Mandible	Anterior teeth	Posterior teeth
caries (adults)	157	32	17	15	6	26
caries (subadults)	28	1	1	0	1	0
calculus	156	44	12	32	15	29
alveolar resorption	53	33	18	15	8	25
antemortem tooth loss	163	5	5	0	0	5
abscess	57	1	1	0	0	1
dental trauma	157	15	8	7	3	12
LEH (adults)	153	49	22	27	25	24
LEH (subadults)	47	15	12	3	8	7

acute periods of stress and growth arrests in childhood;[18] periosteal new bone formation as a measurement of inflammatory responses resulting from systemic bacterial infection, localized traumatic injury, or other pathological processes;[19] fractures,[20] degenerative joint lesions (DJD), vertebral osteoarthritis (OA) and Schmorl's nodes as indicators of habitual activities and lifestyles.[21] Cranial[22] (metopic suture) and dental[23] (Carabelli's trait and shovel-shaped incisors) nonmetric traits were collected for the morphological description of individuals and in order to explore kinship. Dental diseases (dental caries, calculus, occlusal surface wear, alveolar resorption, and antemortem tooth loss)[24] were recorded to assess oral health status and diet. Dental trauma was used as an indicator of food procession, coarseness and non-masticatory functions.[25]

Skeletal lesions were inventoried by presence-absence; the number of individuals affected by a pathological condition is reported (crude prevalence rate). The percentages reflect the observed (n) over the observable (N). DJD were coded by individual when at least one articular surface of the joint was preserved. Dental diseases are reported by the number of individuals affected (crude prevalence rate) and by teeth/sockets (true prevalence rate) for all observable deciduous and permanent teeth.

RESULTS

Demography

The number of individuals is ten, embracing eight adults and two subadults (Table 1). Among the adults, one young (i.e. 20–35 years) and one middle-aged (i.e. 35–50 years) male were identified. Age estimation for juveniles shows one infant (i.e. birth–3 years) and one child (i.e. 3–12 years). No further age-at-death and sex determination was possible.

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[18] Hillson 1996, 166.
[19] Weston 2012.
[20] Lovell 1997, 2008.
[21] Rogers and Waldron 1995; Waldron 2008.
[22] Hauser and De Stefano 1989.
[23] Alt and Türp 1998; Correia and Pina 2002; Kelley and Larsen 1991; Lauc 2003; Scott and Turner 1997; Turner *et al*. 1991.
[24] Brothwell 1981, 151–60; Lukacs 1989, 261–86.
[25] Milner and Larsen 1991, 357–78.

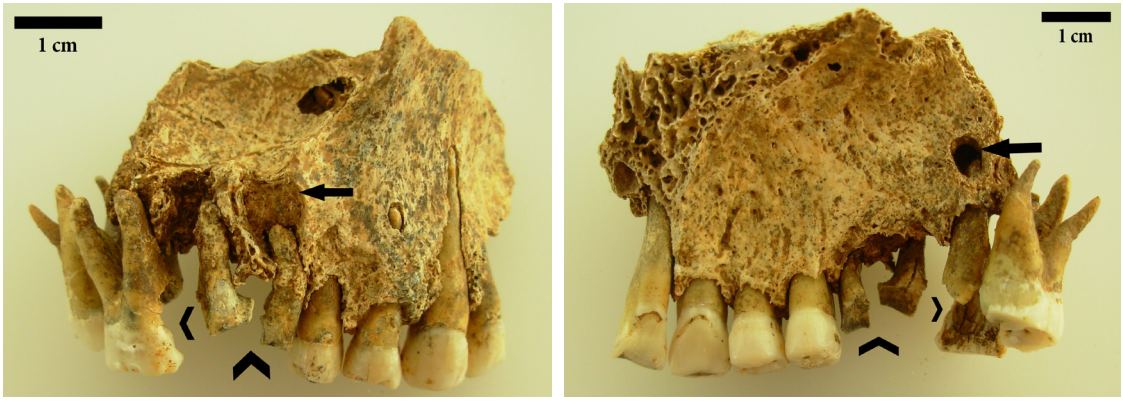

Fig. 4. Right maxilla with alveolar resorption, large dental caries and abscess on the labial (left) and lingual (right) view (middle-aged male from Gr 9).

Nonmetric traits

The two subadults share the presence of Carabelli's trait on the permanent first molars (3 of 11 first upper permanent molars) (Fig. 3). The middle-aged male from grave 9 displays a metopic suture (1 of 6 individuals with observable frontal bone) and the young male from grave 2 has shovel-shaped lateral incisors (2 of 50 permanent incisors).

Dental diseases

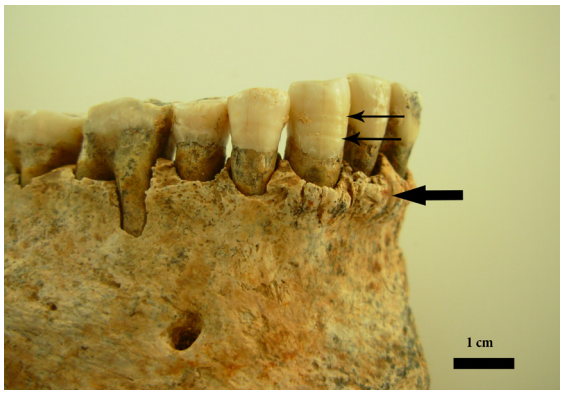

Fig. 5. Linear enamel hypoplasia and mandibular alveolar hyperostosis of anterior sockets (middle-aged male from Gr 9).

Of the seven adults with dental and alveolar remains, all show caries, five have calculus, four display antemortem tooth loss and alveolar resorption, one individual has an abscess (Fig. 4) and alveolar hyperostosis (Fig. 5), and five share dental traumas. The child from Gr 11 has the upper right deciduous canine affected by caries. The true prevalence values for caries and calculus among adults is 20.4% (32 of 157 teeth) and 28.2% (44 of 156 teeth) respectively. Most caries are pits or they affect less than 50% of the tooth (22 of 32 carious teeth). In almost all cases, calculus deposits are slight (41 of 44 teeth with calculus). Dental trauma is manifested by fractures affecting mostly the posterior teeth of the jaws. The lesions consist of antemortem fractures of the dental crowns; the rounded edges of the remaining crowns suggest wear after fracture.

A high frequency of alveolar resorption is noted, affecting 62.3% of sockets; it is manifested by vertical and horizontal bone loss. On the contrary, though, very few cases of antemortem tooth loss and abscesses are observed. It is noteworthy that a source of bias comes from the poor preservation of alveolar remains, since observable sockets are three time less numerous than the number of observable teeth. However, the distribution of dental and alveolar diseases (Table 2) among maxilla and mandible, as well as anterior and posterior teeth, reveals a correlation between caries, dental trauma and alveolar resorption on the posterior teeth of adults; antemortem tooth loss and abscess occur only on the upper jaws. Although frequencies and degrees of occlusal surface wear are not presented in detail here, it is noteworthy that severe attrition with dentin exposure occurred on 90 of 163 observable teeth. Despite severe attrition, the

Fig. 6. Healed fracture (left) on the right scapula with angulation and nonunion, lateral view. Radiograph (right) of the same lesion (middle-aged male from Gr 9).

amount of caries remains high because most of carious lesions are interproximal and cervical.

Linear enamel hypoplasia (LEH) appears on seven of nine individuals (six adults and the child) preserving dental remains (Fig. 5). The true prevalence rate is 32% (64 of 200 teeth) for deciduous and permanent dentitions. Between the two subadults, only the permanent dentition of the child from Gr 11 shows enamel defects. On 64 affected teeth, 99 episodes of LEH are recorded; 44 teeth display one defect episode, eleven teeth have two episodes, and nine teeth show 3, 4 or 5 episodes. The presence of LEH is shared equally between maxillary and mandibular dentitions, and anterior and posterior teeth (Table 2).

Cribra orbitalia and porotic hyperostosis

Cribra orbitalia appears on the orbital roofs of the child (Gr 7) and two of four adults (Grs 4 and 9) with preserved orbits; in two cases the lesions are coupled with surface porosity of the external cranial surface (2 of 7 individuals with vault preserved). The lesions of the child show a mixed reaction of activity and healing, while in adults they are healed. The frontal bones, close to the coronal suture, of three adults (Grs 2, 4 and 6) appear unusually thick, indicating hypertrophy of the cranial vault marrow (8.77mm, 9.93mm, 10.6mm respectively); only one of these individuals (Gr 4) showed cranial porotic lesions on the outer table coupled with healed cribra orbitalia.

Trauma

Two cases of healed fractures occur among adults. In the first case, a well-healed scapular fracture (right side) involves the lateral border, inferior to the glenoid fossa in the middle-aged

Fig. 7. Cloaca on the right tibia showing infection (left), pus drainage canal and nonunion of fracture, posterior view. Radiograph (right) of the same lesion (young male from Gr 2).

adult from Gr 9 (1 of 6 individuals with scapulae). The preserved parts of the neck and glenoid fossa are not injured. Macroscopic and radiological analysis shows a slight anteroposterior dislocation of the two fractured parts and a callus formation (Fig. 6). No periosteal new bone indicative of infection was recorded during the analysis. Clavicles and ribs do not show additional evidence of trauma.

The second case of healed fracture concerns the right tibia of the young male from Gr 2 (1 of 8 adults preserving tibiae). The pathological bone differs in size and shape from its contralateral; the left tibia not being complete, these differences are particularly visible in the circumference at the nutrient foramen that is 8.8cm and 9.7cm for the left and right bone respectively. Furthermore, the right tibia is thickened by the formation of an involucrum at the two proximal thirds of the diaphysis that is more prominent on the lateral surface; it is noteworthy that the right tibia is heavier than the left one. There is a cloacal opening located 15cm above the distal epiphysis on the posterior surface and 8cm below the nutrient foramen (**Fig. 7**, left). The right tibia has an angulation 2cm below the cloaca; this feature is probably due to a fracture that had completely healed at the time of death, but without normal alignment. The thickness of the bone is due to the formation of callus and the posttraumatic periosteal reaction. With radiography, the fracture shows lack of union due to nonunion (**Fig. 7**, right). The presence of cloaca at this point shows that the fracture had suppurated, indicating that it was complicated by a long-term chronic infection, which probably drained through a sinus extending to the overlying skin surface.[26] The cloacal sinus penetrates into the cortical bone at the point of nonunion and into the marrow space. On the medial aspect, the bone shows a hairline fracture (nondisplaced line or crack).[27]

Joint diseases

Bearing in mind the small size and the poor preservation of the sample, joint diseases are the most frequent lesions of the post-cranial skeleton. Osteoarthritis is noted on the spine (4 of 5 individuals), the hip (2 of 3 individuals), the knee (2 of 4 individuals), the ankle (2 of 3 individuals), and the foot (1 of 3 individuals). The lesions are usually expressed by moderate surface porosity.

An unusual lesion appears on the left knee joint of the young male from Gr 2. Due to the poor skeletal preservation only the distal femoral epiphysis and the central part of the patella are observed. More precisely, the analysis revealed a facet that extends from the inner border of the medial femoral condyle into the intercondylar notch (**Fig. 8**). This facet has a defined circumference and its dimensions are 17.19x13.04mm. The surface of the facet shows degenerative lesions including porosity and marginal osteophytes. The facet is slightly depressed but the subchondral bone is not affected. No lesions are noted on the observable patellar fragment.

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[26] Ortner 2003,154.

[27] Lovell 1997, 144.

Periosteal new bone

Five of eight individuals display new bone formation on the lower limbs, in particular tibiae and fibulae. In most cases the lesions are of moderate expression and they are described by reactive woven bone. The infectious complications of the tibial fracture (Gr 2) have been already described above.

Funerary treatment

All graves in the tumulus included individual burials. Adults and subadults share similar features regarding disposal of the body. As far as the grave architecture and cemetery landscape are concerned, the stone-lined pit graves belong to adults and they have variable orientation with one occupying the center of the tumulus (Gr 10). Four of eight adults were furnished either with handmade pottery, bronze knives or bronze jewelry (spiral earrings). When the adult burials' offerings are quantified, it is observed that only five items accompanied four individuals. On the other hand, subadults were buried in simple pits oriented N-S; they were furnished with variable and numerous items: handmade or wheel-made pottery, jewelry (bracelet), clothing equipment (pins) and/or knifes. The quantification of the objects for the subadults shows six items accompanied two individuals. The only Mycenaean-type vase of the cemetery was found in the youngest individual's grave (Gr 1). No particular arrangement of graves, other than that at the center of the tumulus is noted.

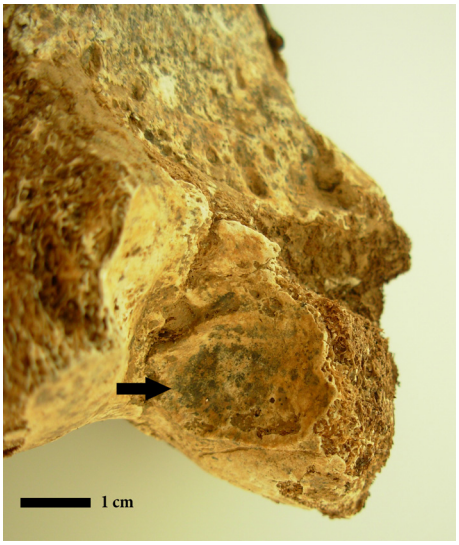

Fig. 8. Facet on the medial aspect of the medial femoral condyle, left side (young male from Gr 2).

The deposit of bones (Gr 8) was found at the northeast part of the tumulus. It comprised the skeletal remains of an adult of unknown age and sex: four mandibular fragments, diaphyses of all the long bones, five metatarsal diaphyses, one right navicular bone, the diaphysis of one clavicle and two, right and left, tali; no particular arrangement of the bones was identified. The cranium and the pelvis were missing. A bronze spiral earring was discovered among the bones. It would be unwise to argue that these bones were removed or selected from elsewhere; a post-depositional disturbance of the bones due to taphonomic or human intervention should not be excluded.

DISCUSSION

The Pigi Artemidos skeletal assemblage was unearthed in a tumulus,[28] a well-organized and spatially defined funerary structure. As far as can be suggested from the small size of the sample, a differential burial treatment can be demonstrated between adults and subadults: stone-lined pit graves (including the central one) were constructed for adults, while numerous and variable items were offered to the dead children.

Comparison between the Pigi Athinas, Valtos, and Pigi Artemidos tumuli shows differences in terms of demography, spatial arrangement, and body positioning.[29] The tumuli of Pigi Athinas include only adults of both sexes, while their central graves held mainly males; in con-

[28] For more details on the tumuli of Macedonian Olympus, see Poulaki-Pantermali 2013, 35–47, 67–70.

[29] Tritsaroli 2010, 192 ; 2017, 252–4.

trast, the central grave at tumulus 1 and the only inhabitant of tumulus 2 at Valtos belonged to females. Body positioning does not show variations between males and females; in both these cemeteries males lay on their right side, while females are placed on their left. On the contrary, the tumulus of Pigi Artemidos contains both adults and subadults. The disposal of the body includes both right and left side flexed positions for the two males. Furthermore, the Pigi Artemidos tumulus is the earliest (LH I/IIB) –so far– among those LBA funerary assemblages in the region of Macedonian Olympus that includes an artifact of Mycenaean type.[30]

All these features testify to important local variations among tumuli cemeteries in regard to mortuary treatment. Males and females alternate as central figures in the tumuli of Pigi Athinas and Valtos, while at the same time subadults are excluded from this mortuary program. On the contrary, subadults and adults share the same funerary space at Pigi Artemidos; the inclusion of subadults corresponds with the presence of a Mycenaean-type vase in the tumulus. Mycenaean types of artifacts are common in the later cemetery of Spathes, located on a steep slope of Upper Mount Olympus about 50km north-west of the aforementioned tumuli. At Spathes, the standardization in the mortuary treatment can be seen in the adoption of a particular grave type, burial position and orientation as well as the use of certain categories of burial offerings, usually including personal items recalling Mycenaean types that emphasize the social identity of the deceased.[31] As a consequence, at Pigi Artemidos, the association of a traditional layout of the burial space (tumulus) with the inclusion of subadults, the difference in quantity and variety of burial offerings between adults and subadults, and the evidence of a new material culture constitute new funerary attitudes at the dawn of the LBA in the region of Macedonian Olympus.

Teeth provide an important source of information regarding health, diet, habitual activities (e.g. extra-masticatory use of teeth) and cultural or ritual practices (e.g. dental ablation). The present analysis has revealed an unusually high frequency of dental calculus, caries, alveolar resorption, linear enamel hypoplasia, and dental trauma. Calculus is a mineralized plaque deposit seen on the surface of teeth; several factors are responsible for the variation in the extent of calculus deposits among individuals, including salivary flow, inherited, dietary and other factors.[32] Dental calculus can irritate the gingival tissues and cause inflammation and periodontal disease. In archaeological samples an alkaline oral environment and chronically poor oral hygiene is considered to be responsible for the amount of calculus.[33] Recently, analysis of microfossils (e.g. starch granules) and chemical compounds extracted from dental calculus provides a direct way to investigate, among others, plants digested by humans in past populations.[34] Caries is considered an infectious disease initiated by microbial activity on the tooth surface in which tooth structure, crown or root are progressively destroyed; cariogenic activity can be also stimulated by factors intrinsic to the tooth structure, such as developmental defects in the quality of enamel.[35] A correlation exists between agricultural subsistence economies and sugars including fermentable carbohydrates[36] which interact with plaque bacteria to cause demineralisation.

Frequencies of dental pathologies at Pigi Artemidos are generally higher when compared

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[30] Koulidou 2014; Poulaki-Pantermali 2013, 46.

[31] Triantaphyllou 2001, 2003.

[32] Hillson 2005, 289.

[33] Lukacs 1989, 283; Little and Hazen 1964, 645–51; Little *et al*. 1963, 78–86.

[34] Hardy *et al*. 2009, 248–55; Buckley *et al*. 2014, 8.

[35] Ortner 2003, 590.

[36] Lukacs 1989, 267.

to the prehistoric populations of Pigi Athinas, Valtos[37] and Spathes[38] from the same region. So far, it cannot be assessed if these differences represent variations in subsistence, diet or food preparation. Stable isotope analyses for Spathes has shown a preference for a terrestrial C_3-type diet and a rather minimal intake of animal protein,[39] while macroscopic investigation of dentition indicated a reliance on carbohydrates.[40] Bearing in mind the small sample size from Pigi Artemidos, the status of the dentition suggests that these people had poor dental health and a diet with some protein intake, although this hypothesis and the source of the protein consumed needs to be further investigated by stable isotope analyses. Finally, heavy wear and dental trauma exposing the tooth pulp and damaging the dental structure should be linked to the consumption of a fairly abrasive diet or food-processing techniques.

Cranial porosities, cribra orbitalia, marrow expansion and linear enamel hypoplasia are among the most commonly used pathological markers of deprivation in archaeological samples. In the vast majority of cases, cranial lesions are the skeletal expression of an elevated red blood cell production in response to anemic conditions related to nutritional deficiencies or vitamin malabsorption.[41] In this study as well, the mild expression of the lesions suggests an acquired rather than a genetic form of anemia. Linear enamel hypoplasias result from the disruption of normal enamel growth caused by physiological stress, such as malnutrition or illness, hereditary anomalies or localized traumas;[42] however, in the majority of cases recorded in archaeological populations these defects are linked with systematic physiological stress. The pattern and frequency of linear enamel hypoplasias in the sample examined here indicate that a poor growth environment resulting in multiple episodes of stress and growth arrest was frequent in the early life of these individuals.

Although small in size, the sample includes two cases of skeletal trauma displayed by males, both involving the appendicular skeleton. Analysis of traumatic lesions is largely informative about the human past and provides information on occupational activities, environmental hazards and interpersonal violence.[43] Scapular fractures are uncommon in archaeological collections and they are usually the result of direct trauma.[44] Evidence from modern clinical record[45] informs us that this injury can be caused by a blow or a fall. In the case of a fall from a standing height, the injury should not be that severe[46] and when a free fall from a great height has occurred, then multiple injuries should be recorded.[47] In the case of Pigi Artemidos, only the scapula is involved without additional injuries; the severity of the lesion suggests rather a violent episode[48] than accidental injury.

The second case of trauma consists of a fracture with evidence of infection on the right lower limb. The severity of the fracture is indicated by a cloaca in the posterior aspect of the nonaligned tibia. In addition, the nonunion of the bone suggests that this was an open fracture, a feature that appears when the bone protrudes through the skin or the skin is injured

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37 Tritsaroli 2010, 193; 2017, 239.

38 Triantaphyllou 2001, 117–32.

39 Triantaphyllou 2015, 67–8.

40 Triantaphyllou 2001, 141.

41 Larsen 2005, 31–2, 39.

42 Goodman and Rose 1991, 279–94; Hillson 1996, 166.

43 For an overview, see Lovell 1997 and 2008.

44 Lovell 1997, 160; 2008, 357.

45 Butters 2006, 1257–84.

46 Galloway 1999, 251–2.

47 Galloway 1999, 251–4; Kimmerle and Baraybar 2008, 181–95.

48 A well-healed blunt force scapular fracture is reported in the literature on a female from Harappa (Pakistan) and it is suggested that it resulted from violence (Lovell 2014, 1–4).

to the level of the bone.[49] Open fractures are prone to infection. Depending upon the ability of the immune system to combat effectively the infection, a body response is visible in the form of periostitis (inflammation of the periosteum) or osteomyelitis (infection of bone involving the marrow).[50] Cloaca (a pus drainage canal in the involucrum) or sequestration in association with periosteal bone formation (involucrum) is the best diagnostic evidence for osteomyelitis in skeletal samples.[51] It is known from the literature that fractures can occur secondary to pathology;[52] however, in the case presented here, we consider that the fracture did not occur secondarily to a disease already present in the body because the cloaca and the pus drainage canal appear at the point of nonunion of the bone. Bearing in mind all the above criteria, we suggest that the young male from Gr 2 suffered a posttraumatic osteomyelitis.

The left limb of this young male displays degenerative changes on the knee joint. This case is reported in the modern clinical record as a facet on the medial aspect of the medial femoral condyle.[53] The mechanism that produces this facet is described by Goodfellow et al. (1976) and it involves the patellofemoral contact areas. When the knee is flexed beyond 135 degrees, the patella rotates slightly; in extreme flexion the majority of the patella recesses into the intercondylar notch.[54] In this degree of flexion, the odd medial facet of the patella (an odd facet that is separate from the medial patellar facet proper) articulates with the lateral margin of the medial femoral condyle and may cause cartilage lesions found on the patellofemoral syndrome.[55] This high degree of flexion occurs only in extreme activities. This area matches the site where osteochondritis dissecans appears,[56] a pathological condition that affects the subchondral bone and surrounding cartilage of synovial joints, such as the knee, elbow, and ankle. However, in the case of the individual from Gr 2 the lesion is not on the joint surface, but in the intercondylar fossa. As such, we suggest that the facet observed on the left distal femur is the result of extreme flexion of knee joint that led to osteoarthritis. Evidence of habitual posture recorded on the same skeleton includes squatting facets on both tibiae and tali thus further supporting the hypothesis of flexion of the knee in squatting postures.[57] Bearing in mind the moderate preservation of the skeleton, we were not able to establish a relationship between knee osteoarthritis related to habitual posture and posttraumatic infectious disease that appears in the right lower limb.

CONCLUSIONS

The Pigi Artemidos sample comprises only a small part of the living prehistoric population from which it derived. The sample was held in a well-defined funerary structure. Evidence of age-related mortuary variability is suggested by grave architecture (stone-lined pits for adults with or without stone marker and simple pits for subadults), orientation of burials, and grave offerings.

The skeletal analysis revealed an important number of paleopathological conditions, sometimes unusual. Dental caries, periodontal disease and posttraumatic osteomyelitis are indicative of the exposure of these individuals to infectious agents; nevertheless, the involvement of

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[49] Lovell 1997, 146.

[50] Lovell 1997, 146; Ortner 2003, 181.

[51] Ortner 2003, 199.

[52] Lovell 1997, 144; 2008, 347.

[53] Goodfellow *et al*. 1976, 287–90.

[54] Rothschild and Woods 2012, 10–11.

[55] Goodfellow *et al*. 1976, 290.

[56] Ortner 2003, 351–3; Aufderheide and Rodriguez-Martin 1998, 81–3.

[57] Kennedy 1989, 129–60.

teeth and bones suggests chronic rather than acute infectious diseases. Skeletal trauma and markers of occupational activity on the appendicular skeleton of two males are indicative of the general lifestyle conditions: they include lesions related to accidental circumstances (tibial fracture) during activity or possible physical confrontation (scapular fracture) of violent origin. Finally, stress and deprivation during growth and development point to impoverished environmental circumstances. In sum, health conditions at Pigi Artemidos show energetic and physically active individuals, while some adaptation to environmental constraints can be suggested. The absence of a demographic profile for adults hinders considerably the interpretation of the recorded features and no further inferences regarding host resistance can be produced.

The bioarchaeological analysis of prehistoric populations from the region of Macedonian Olympus shows inter-cemetery variations among tumuli assemblages that likely reveal locally diverse lifestyles and funerary expressions, while the comparison between the aforementioned tumuli and the cemetery of Spathes further illustrates temporal variations that indicate emergent forms of new mortuary attitudes in LBA northern Greece.

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