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PALEOANTHROPOLOGICAL INFERENCES REGARDING FOUR SKELETONS FROM AN ARCHAEOLOGICAL CONTEX AT GHERĂSENI, BUZĂU COUNTY

Claudia Radu[1], Vlad-Andrei Lăzărescu[2], Szeredai Norbert[3], Cecilia Chiriac[4], Bogdan Ciupercă[5]

Abstract: *Four skeletons discovered at Gherăseni, Buzău County, were analysed using methods from osteology, paleopathology, and FT-IR spectroscopy. Furthermore, due to the doubtful relative dating for this sample, we performed C14 dating. Besides the determination of standard biological attributes like the sex determination and age-at-death for each individual, further analysis revealed the presence of pathological changes on the skeletons belonging to two females. For the differential diagnosis carried over these lesions (eburnation, severe marginal lipping and osteophytes of great dimensions, ankylosis of vertebral bodies, kyphosis, intervertebral disc disease) we took into consideration osteoarthritis, spinal ankylosis, erosive osteoarthritis, spondylolisthesisand infectious disease possibly tuberculosis. The latter possible diagnostic was additionally explored using infrared spectroscopy. Although the sample is too small for inferring conclusions at a populational level, the paleopathological results offer important data regarding the population inhabiting the Subcarpathic area in the Neolithic, Early Migrations, and Medieval periods.*

Keywords: *bioarchaeology, joint disease, arthritis, physical anthropology, infrared spectroscopy*

The present article is meant to describe the anthropological data derived from the osteological analysis of four individuals discovered in the year 1965 in the village of Gherăseni (Buzău County, Romania). An approximate dating for these 4 skeletons, nowadays found in the archaeological collection of Prahova County Museum of History and Archaeology, was possible based on an unpublished manuscript from Victor Teodorescu, the archaeologist who

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began excavations in this site[6]. The archaeological activities at Gherăseni began in 1959 and until 1961 were coordinated by Victor Teodorescu; starting with 1963 Gheorghe Diaconu joined the team[7]. After 1965, the excavations were stopped until 1989 when they were resumed by Eugen Marius Constantinescu until 2008[8]. Several archaeological contexts were discovered during these campaigns out of which the most important were those belonging to the Neolithic and to the Early Migration Period[9]. Yet, C14 analysis provided a dating in the Medieval Period for the skeleton from grave no. 4, initially considered to be part of the Neolithic cemetery also discovered here[10].

The importance of the contexts dated during the Early Migration Period is given by the fact that one of the graves contained a golden diadem, a type of find usually linked with the princely graves belonging to the Hunnic period[11]. The fact that this small group of graves is situated near an older necropolis belonging to the 4th century AD[12] raises the importance of the site even higher, having profound implications regarding the realities that occurred during this era. What was the chronological relation between these two is only a first question that can be asked while dealing with such archaeological contexts. Unfortunately, the conditions in which the graves that will be approached by this article were uncovered do not provide sufficient data for such a question to be either asked or answered, but instead we will try to shed some light on other aspects that we can learn by studying the skeletal remains that were recovered back in 1965.

The first problem that we faced was that of chronologically ordering the graves. Fortunately, as already mentioned, the manuscript of Victor Teodorescu came to the rescue. By studying the text we learnt precious information that was previously unknown such as the orientation and shape of the grave pits.

In April 1965 a first grave, partially disturbed, noted as M1 (best known as the grave containing the diadem) emerged and immediately after its discovery massive rescue excavations were planned and executed. Grave M1, partially destroyed by the villagers working in the sand quarry, was oriented on an ENE-ESE axis having a relatively large and ellipsoidal contour, being found at an approximated depth of 2.5 meters. The deceased was carefully placed on its back

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[6] The manuscript probably represents a written report for the County Administrative Office who financed the excavations that year. Unfortunately it was never published and was found only a few years ago after Victor Teodorescu passed away. With this occasion we would like to thank the family of Victor Teodorescu who kindly allowed full access to all the documentation regarding the archaeologists' activity.

[7] DIACONU 1973; DIACONU 1977; DIACONU 1983; CONSTANTINESCU 2010, 257; COSTACHE/STĂICUȚ 2013, 17–18.

[8] CONSTANTINESCU 1992; CONSTANTINESCU 1994; CONSTANTINESCU 1996; CONSTANTINESCU 2010, 257; COSTACHE/STĂICUȚ 2013, 17–18.

[9] From the Neolithic a settlement and its necropolis is known and from the Early Migration Period the excavations demonstrated the existence of two settlements and a biritual necropolis belonging to the Sântana de Mureș – Černjachov culture as well as a small group of graves from the Hunnic period, see CONSTANTINESCU 2010 and SOCTACHE/STĂICUȚ 2013, 17–18 for more details.

[10] Conventional radiocarbon age: 1010 +/- 30 BP; 2 Sigma calibrated results with a 95% probability Cal AD 985 to 1040 (Cal BP 965 to 910) and Cal AD 1110 to 1115 (Cal BP 840 to 835). C14 dating was performed at Beta Analytics Inc. Laboratory, Miami, Florida, USA.

[11] HARHOIU 1998, 176. For more recent details and interpretations regarding the problem of the Hunnic period centres of power, see CIUPERCĂ/MĂGUREANU 2008; CONSTANTINESCU/CIOBANU 2008.

[12] The archaeological contexts documented for this site determined Gheorghe Diaconu to postulate the existence of a particular aspect of the cultural group Sântana de Mureș – Černjachov which would have comprised a much stronger local aspect, the so-called "*Târgșor – Gherăseni aspect*", see DIACONU 1964; DIACONU 1976; DIACONU 1977. Although this type of clear cultural delimitation approach is not used nowadays by the Romanian archaeological literature, an updated scientific discussion regarding the possibility of such an assumption to be true or false is lacking.

having his hands stretched along the body. Several items were recovered from the grave such as: a golden inlayed diadem placed on the skull of the deceased, a mirror found near the pelvis of the skeleton, several course greyish pottery fragments coming from the same vessel placed near the left femur and possibly a loom weight recovered from the area of the feet[13]. Several opinions were formulated regarding this grave and there is no doubt regarding its dating during the D2 horizon[14].

If the dating of the first discovered tomb in that area is quite easy to establish, we can't say the same about the other ones. Out of the whole seven graves excavated with that occasion, two were almost entirely destroyed, namely M3 and M7. Graves M4[15] and M6 were thought to be of Neolithic origin, thus only two more tombs (M2 and M5) remain to be fitted into the chronological framework of that area. Concerning M2, due to its close vicinity with M1 and their common characteristics, V. Teodorescu believes that both of them must have the same chronology. M2 is described as being situated 10–12 meters SSV from M1, having its upper part destroyed. It was oriented on an N-S axis its pit being of rectangular shape. The depth of the grave was of about 2.1 meters. The deceased was carefully placed on its back having his hands stretched along the body. Several items were recovered from the grave such as: two small buckles found near the feet of the deceased, an iron object poorly preserved found near the left side of the pelvis, traces of an ellipsoidal wooden object (approx. 9.5 × 4 cm) visible right near the left femur and traces of animal offerings carefully placed on each side of the deceased's femurs[16].

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[13] cf. to V. Teodorescu's manuscript: "[…] Conturul gropii, perfect vizibil, contrastând cu galbenul limoniu al pământului din jur, era larg-oval, ușor biunghiular spre picioare. Fundul era plat, mai ridicat spre craniu […] Cercetând sistematic, am găsit *in situ* câteva fragmente de coaste, radiusul stâng cu o parte din carpienele și falangele respective, bucăți de bazin, totul orientat ENE-VSV, câteva carpiene și falange drepte în conexiune anatomică, peroneul drept puțin știrbit și orientat ENE-VSV, precum și tarsienele și falangele lor stângi. Pe baza acestor detalii, coroborate cu informațiile primite, se poate deduce just că mortul fusese întins pe spate, cu mâinile de-a lungul trupului, cu capul la ENE și picioarele la VSV. Față de axul gropii, se pare că mortul zăcea ușor oblic. Pe fundul gropii, am mai descoperit *in situ*: aproximativ în zona brâului mortului, o oglinjoară de metal cu tortiță dorsală în jurul căreia se dezvoltă un decor de nervuri radiale, intersectând două cercuri concentrice; spre latura stângă a gropii, în zona bazin-femur, trei fragmente ceramice zgrunțuroase, provenind din același vas; la vârful picioarelor, o jumătate de greutate de lut în formă de colac; în preajma fragmentelor ceramice, au fost observate multe firișoare de cărbune, în parte suprapuse de radius-ul stâng *in situ*. Judecând stratigrafic și topografic, adâncimea mormântului era de peste 2,00 m, fundul său găsindu-se la 2,50 de la suprafața actuală reconstituită. Tipul gropii funerare (simplă sau catacombă?) nu poate fi precizat" (**sic!**). We can easily see the discrepancies between this description and the one offered by R. Harhoiu in his monograph concerning the Early Migration Period in Romania where he mixes up the finds from graves M1 and M2 while failing to present other items found in the same tombs: "[…] An der nord-nordöstlichen Grenze der Siedlung, ungefähr 200 m von Grab 23 entfernt, stieß man auf eine Gräbergruppe (Zahl der Gräber unbekannt), von denen nur ein Diademgrab bekannt ist aber noch immer nicht veröffentlich vurde (Abb. 11). […] **Diademgrab**: Körpergrab; Frau; andere Angaben fehlen: **1.** goldenes **Diadem** (L.: 23,5 cm; Br.: 4,3 cm) (Typ IV.1.1) (Taf. LXXVII/B:1); **2. Spiegel** mit Zentralöse (Dm.: ~6 cm) (Typ IX.3) (Taf. LXXVII/B:4); **3.**scheinbar an der Füßen: zwei bronzene **Schuhschnallen** (Dm.: ~2 cm) (Typ IV.6.2) (Taf. LXXVII/B:2–3)." (**sic!**), see HARHOIU 1998, 176 which can be easily explained by the fact that R. Harhoiu didn't had access to the original documentation see below note 14.

[14] HARHOIU 1998, Taf. CXXXVII.

[15] Our C14 analysis performed on a sample taken from this skeleton gave us a dating in the 11$^{th–12th}$ century AD, a reality which complicates even more the understanding of the chronological stages of the site. At this moment it is quite clear that a reassessment of the already known data from this site must be done after analysing more C14 samples.

[16] cf. to V. Teodorescu's manuscript: "[…]Se afla în peretele vertical al carierei, la 12 m SSV de M1, ceva mai spre (nu însă la) poalele grindului. De la cap până la cotul drept și bazinul stâng, fusese distrus de săteni (oasele recuperate). Restul, cercetat de noi, *in situ*, perfect întins pe spate, cu mâinile de-a lungul trupului, cu labele picioarelor ușor suprapuse. Orientat N (cap) – S, ușor oblic în groapa dreptunghiulară puțin strâmtată spre picioare, cu fundul plan și colțuri rotunjite. Un obiect mic de fier indeterminabil datorită degradării (amnar?), la șoldul stâng. Lângă

The last grave that can be correlated with the Early Migration Period is M5. Although the tomb is situated further away from the first two graves it is still part of the small group uncovered in 1965. The tomb has no funerary inventory but the fact that the deceased is oriented on a V-E axis, placed on its back with his hands along the body may very well relate this discovery to the group of late burials typical to the Sântana de Mureș – Černjachov cemeteries[17].

We can now conclude that we have reasons to believe that at least three tombs out of the total number of seven graves discovered during the rescue excavations undertaken in 1965 belong to a small burial site dated during the first half of the 5th century AD, while one grave is linked to the Neolithic and another one to the Medieval period. Unfortunately we cannot make the same sort of remarks regarding graves M3 and M7 which although are quite close to the first three contexts already mentioned because of their poor state of conservation render us unable to formulate further assumptions regarding their dating.

Materials and methods

The skeleton has the ability to remodel during the life of an individual and therefore offers the possibility to infer from its observation various osteological changes which in turn provide us with data regarding the life history of these individuals[18]. Although the small size of this sample does not allow for an analysis at a populational level, the pathological findings observed on the skeletons offer interesting new data regarding this population.

The material was analysed following the guidelines provided by Steckel et al. (2011)[19] and Buikstra and Ubelaker (1994)[20]. Aside from the determination of age at death and sex, our observations included the assessment of the degree of representation and preservation of the skeletal material, the analysis of dental and skeletal pathology, and metric measurements. The paleopathological analysis was focused on the presence of degenerative joint disease, osteoperiostitic lesions, *cribra orbitalia*, porotic hyperostosis, Schmorl's nodes, intervertebral disc disease, and trauma and fractures[21]. Stature was calculated using the formulae from Pearson (1899), Trotter and Gleser (1958) and Bach (1965)[22].

The graves contained the remains of four individuals, showing different conditions in what regards their representation and preservation. This has restricted to a certain degree the osteological analysis by hindering the observation of specific markers and features. For the individual from grave no. 3, the age-at-death could not be inferred due to the lack of skeletal material. All of the individuals are adults, one being a male and the other three females (Table 1).

The individual from grave no. 2 is a female with an age-at-death between 20 and 24 years. The skeleton is poorly preserved in regard to both the skeletal elements and the cortex of

diafiza femurului stâng, în afară, urma plată, ovală, (9,5 × 4,0 cm) a unui obiect de lemn putrezit. Două catarame de fier – simple, mici, aproape rotunde (diam: 2 cm), puțin îngroșate spre partea de vârf a spinului ușor arcuit peste veriga cu profil oval – se aflau la picioare, una la glezna stângă, alta deplasată la 9 cm de glezna dreaptă. Două resturi de ofrande (oase de animal) încadrau femurele defunctului la dreapta și la stânga. Mortul zăcea la –2,05 m de la suprafața actuală. Adâncimea gropii mormântului, reconstituită, de cca. 1,65 m (nivelul de săpare distrus de treptele unei pivnițe din sec. XVIII, care coboară până la între 0,40 și 0,05 față de oasele mortului)." (**sic!**).

[17] cf. to V. Teodorescu's manuscript: "[…]Al treilea mormânt, M5, izolat, fără inventor, întins pe spate cu capul la vest având mâinile de-a lungul trupului, aminteşte de mormintele sarmatice târzii de la Târgşor (grupa IIIC, sec. IV e.n.), dar în cazul nostrum are datare incertă." (**sic!**). Similar contexts are quite numerous and very well documented in almost every such type of necropolis, see for example DIACONU 1965; PALADE 2004; ŞOVAN 2005.

[18] LARSEN 2002; KNUDSON/STOJANOWSKI 2008; LARSEN/WALKER 2010.

[19] STECKEL ET ALII 2011.

[20] BUIKSTRA/UBELAKER 1994.

[21] ORTNER 2003; WALDRON 2009; PINHASI/MAYS 2008, AUFDERHEIDE/RODRIGUEZ-MARTIN 1998; WALKER ET ALII 2009; LOVELL 1997.

[22] PEARSON 1899; TROTTER/GLESER 1958; KOZAK 1996.

the bone. Unfortunately, most of the upper part of the skeleton was not available for observation and neither were there any teeth preserved. None of the existing joint elements (n=15) presented pathological changes indicative for osteoarthritis. Six long bones were screened for the identification of osteoperiostitis, but no lesions were found on either bone. Based on the maximum length of the femur (432 mm), stature was calculated using the formulae from Pearson (1899), Trotter and Gleser (1958) and Bach (1965). The results vary from 156.86 cm to 163.41 cm (see Table 1).

Table 1. Distribution of sex, age-at-death, degree of representation and preservation, and estimation of stature (in cm).

Grave No.	Sex	Age-at-death	Representation[a]	Preservation[b]	Stature I[c]	Stature II[d]	Stature III[e]
2	F	20–24	0–50%	0–50%	156.86	160.8	163.41
3	F	ADULT	0–50%	0–50%			
4	F	43–58	75–100%	50–75%	153.17	156.11	160.91
5	M	33–42	0–50%	0–50%	161.48	164.42	

a % from the bones present for observation.
b % from the compact tissue of the bones present for observation.
c Stature calculated using regression equations provided by Pearson (1899).
d Stature calculated using regression equations provided by Trotter and Gleser (1958).
e Stature calculated using regression equations provided by Bach (1965).

Table 2. Distribution of degenerative joint disease by major joints. Although in the analysis both sides were taken into consideration, here we used the result from the most affected side.

Joint/ Grave No.	Shoulder	Elbow	Wrist and Hand	Vertebrae	Hip	Knee	Ankle
2	0*	1	1	0	1	1	1
3	3*	1	2	3	0	2	0
4	2*	2	2	3	2	2	1
5	1*	2	2	2	0	0	0

*0 Joint not available for observation.
*1 Joint is present for observation but no pathological changes were seen.
*2 Slight pathological changes like small osteophytes and marginal lipping.
*3 Severe pathological changes, with eburnation and alteration of joint contour[23].

The individual from grave no. 3 is an adult female. A more precise biological age could not be determined due to the lack of diagnostic elements. The skeleton is poorly represented, preserving only bones of the upper limbs and axial skeleton. The clavicle, both humeri, and the right radius were the only available long bones present for observation. None of these showed osseous changes indicative for osteoperiostits. Still, degenerative modifications were seen on the existing joints. The left clavicle shows extensive erosion of the sternoclavicular articulation, with severe erosion of the subchondral bone and destruction of the cortex on the clavicular side (Fig. 1). Moreover, marginal lipping and osteophytes are present on the joint margin. The left humeral head also shows arthritic changes with eburnation on the superior pole of the humeral head and severe marginal lipping (Fig. 2). The vertebrae are in a high state of fragmentation. On the preserved elements, both the diarthrodial and the amphiarthrodial joints are affected, with posterior spinal ankylosis, osteophyte formation and intervertebral disc disease (Fig. 3 and 4). These conditions affected both the cervical and the thoracic vertebrae. Unfortunately, the extent of the changes cannot be inferred because much of the spinal column is missing. The distal right

[23] STECKEL ET ALII 2011, 32–33; WALDRON 2009, 34.

femur also shows moderate marginal lipping on the condyles. Last but not least, on a right rib we could observe a healed fracture, partially aligned (Fig. 5). The fragmentary state of the bones did not allow for stature to be calculated.

Grave no. 4 contained the remains of a female individual of 43 to 58 years at the moment of death. The skeleton is well represented, preserving also a number of 16 teeth. Dental analysis showed that the individual lost two teeth antemortem and had three carious lesions. Dental calculus was seen on both the maxillary and mandible. Dental wear on the molars was present in a moderate form. Although most of the long bones were preserved, none of them showed periostitic changes on the diaphysis. Porotic hyperostosis was seen on the external table of the skull, but lesions specific for *cribra orbitalia* were not present on the orbital roofs. Arthritis was observed on the majority of the joints, the most severe affected being the vertebrae. A number of 4 vertebrae are missing, but on the remaining elements several pathological changes could be seen. C6 with C7, T7 with T8, and T10 with T11 were fused anteriorly and their size greatly reduced (Fig. 6). T9 collapsed anteriorly resulting in the flattening of the vertebral body (Fig. 7). Moreover, on the inferior end-plate of L5 and the superior end-plate of the first sacral vertebra, the surface is severely modified, with complete destruction of the cortex and the formation of bony spurs on the entire area of the plates with an inflammatory aspect (Fig. 8). All of these changes led to marked kyphosis of the vertebral column (Fig. 7). Schmorl's nodes were present on the bodies of L1 and L5. In addition, on the medial condyle of the right femur we observed a longitudinal trauma, measuring 28.12 mm (Fig. 9). Lack of osseous reaction at the margins of the cut suggests that it was made perimortem. Stature was calculated based on the length of the femur (432 mm) by using formulas from Pearson (1899), Trotter and Gleser (1958), and Bach (1965). The results are 156.86 cm, 160.8 cm, and 163.41 cm, respectively.

The skeleton from grave no. 5 belongs to a male individual with an age-at-death of 33 to 42 years. As in the case of graves no. 2 and 3, the degree of preservation and representation is poor and dentition was not present. Osteoperiostitis was not found on the preserved bones. Of the seven joint elements available for observation, four show slight degenerative changes specific for osteoarthrosis: the right distal humerus, right distal radius, right proximal ulna and the lumbar vertebral region. Based on the maximum length of the radius (231 mm), stature was calculated with the formulas of Pearson and Trotter and Gleser, the results being 161.48 and 164.42 cm, respectively.

Discussion

The results offered by the osteological analyses provide additional knowledge regarding the archaeological populations inhabiting the Sub-Carpathic area during the Neolithic, Early Migration, and Medieval periods. As said earlier, the interpretation of the results is hindered by the small number of individuals. Still, the sample offers interesting information from a paleopathological point of view. Unfortunately, the poor degree of representation and preservation of the skeletons belonging to the individuals number 2 and 5 do not allow us to make inferences regarding their life-histories. Yet, the pathological changes seen on the skeletons belonging to the individuals no. 3 and 4 can be discussed.

The osseous modifications seen on the skeleton belonging to individual no. 3 suggests this woman might have been suffering from either osteoarthritis, which is a proliferative condition (characterised by the production of bone) or an erosive form of joint disease (we considered here erosive osteoarthritis and ankylosing spondylitis). Five joint elements were affected by arthritic changes. On the humerus, eburnation on the superior pole of the humeral head and the rim of osteophytes around the same area are specific for individuals suffering from impingement syndrome, which is a complication of the rotator cuff disease and usually affects

the humeral head and the subacromial tissues[24]. Eburnation is considered to be pathognomonic for osteoarthritis[25]. Anterior ankylosis of the vertebrae and intervertebral disc disease are also frequently present in complications of osteoarthritis. Erosive osteoarthritis (EOA) is diagnosed usually by degenerative changes on the bones of the hands[26], most of which in our case are not preserved, except one phalange from the hand and one from the foot. These existing elements do not show any pathological change. Moreover, EOA does not usually involve the spine, which is not consistent with the lesions discussed here. Due to the fragmentary state of the skeleton, ankylosing spondylitis (AS) might represent a diagnostic for the condition present on the skeleton of individual no. 3. AS usually affects the sacroiliac joints[27] which in our case are not preserved and therefore we cannot assess if there were any pathological modifications. Moreover, spinal fusion with the aspect of "bamboo spine" and syndesmophytosis are also characteristic of AS, but in our case the fragmentary state of the spine does not allow us to be certain as to what degree were the vertebrae affected and consequently this diagnostic cannot be ruled out entirely. We consider that the most reliable diagnostic is that of hyperthrophic polyarticular osteoarthritis.

For the differential diagnostic for the pathological findings seen on the skeleton of individual no. 4 we took into consideration osteoarthritis, erosive osteoarthritis, ankylosing spondylitis,spondylolisthesis, and infectious disease, most probably tuberculosis. Osteophyte formation and intervertebral disc disease are associated with osteoarthritis like in the case of individual from grave no. 3, but osteoarthritis can be primary (without a specific cause) or secondary (associated with a trauma or infectious disease)[28]. Spinal ankylosis of the three pairs of vertebrae and the collapse of T9 have resulted in marked angular kyphosis, which in turn is a diagnostic for Pott's disease[29]. This condition is the spinal manifestation of tuberculosis. Waldron (2009, 95) defined the operational definition for spinal tuberculosis based on the presence of lytic lesions on the vertebral bodies, vertebral collapse, vertebral ankylosis, kyphosis, and lack of new bone formation[30]. He also states that occasionally lesions on the anterior side of the vertebral body can be present due to an infection beneath the anterior longitudinal ligament. The two thoracic pairs of fused vertebrae both show this kind of lesions with osseous destruction. Moreover, the osseous reaction seen on the end-plates of L4 and L5 is consistent with the presence of an infectious disease but it could also point to spondylolisthesis associated with a complication that could have led to an inflammation of the cartilage because the morphology of the proliferative bone seen on both vertebrae is suggestive of a hypertrophic process which was active at the time of death[31]. Aside from these conditions, another possible diagnostic is secondary osteoarthritis due to a trauma or an infection of the lumbar and sacral vertebrae which in time, due to biomechanical stress, could have led to kyphosis. The morphology of this pathological feature is more likely an indicator of an infectious reaction rather than just osteoarthrosis. The latter, although it can be athrophic (the production of only a small amount of new bone), is mainly characterised by bone formation[32]. Therefore, it can be a diagnostic for the arthritic changes seen on the rest of the body (the extraspinal joints) which in turn can be a consequence of the severe kyphosis experienced by this individual and which

[24] WALDRON 2009, 40–41; MILES 2000, 162.
[25] WALDRON 2009, 27–28; ORTNER 2003, 547; AUFDERHEIDE/RODRIGUEZ-MARTIN 1998, 95.
[26] WALDRON 2009, 52.
[27] WALDRON 2009, 53–60.
[28] ORTNER 2003, 546–547.
[29] WALDRON 2009, 94.
[30] WALDRON 2009, 95.
[31] MAYS 2006.
[32] WALDRON 2009, 47.

would have increased the amount of biomechanical stress placed on the other body parts. Other erosive joint diseases can be ruled out due to spinal involvement or lack of sacroiliitis and dactylitis[33]. Summing up, we consider that the lesions seen on the skeleton of this individual have an etiology in either infection with *Mycobacterium* species or in a complication of the inflammatory process present on the lumbar vertebrae. These hypotheses were further explored using infrared spectroscopy. Additionally, the same set of analyses was performed also on bony tissue from the individual from grave no. 3.

We have conducted a series of analyses designed for mycolic acids identification. Mycolic acids are the dominant constituents of the cell envelope in *Mycobacterium* species, being long fatty acids made up mainly of methylene groups and several methyl groups. Their presence in ancient human remains has been previously investigated using Fourier transform infrared spectroscopy (FT-IR) and were found to be useful biomarkers in tuberculosis diagnosis[34]. We applied the same methodology and observed that there are absorptions peaks at 2935 cm–1 and 2860 cm–1, where methylene and methyl groups absorb radiation and also at 1470 cm–1 and 720 cm–1, as a result of long chain deformations (Fig. 10). Therefore, it it highly possible that the samples contain long linear aliphatic chains resembling the mycolic acids features in FT-IR spectra.

Using FT-IR we calculated the crystallinity index (CI) as the ratio between the sum of the absorbance values of the degenerating phosphate ion antisymmetric bending frequencies and the valley between them[35]. Modern bones have CI values about 2.7–3 but archaeological bones CI usualy exceed 3[36]. In the case of tuberculosis affected individuals the CI value is reduced compared to the expected one. CIs calculated for M3 and M4 individuals are 3.04 and 2.65 respectively, resembling the values reported in literature for tuberculosis affected bones[37].

Another index that is altered in tuberculosis infected bones is the carbonate content (CO3/PO4) measured as the ratio between the absorption values at 1415 and 1035 cm–1[38]. The average value among healthy bones is 0.23 but the indices calculated for M3 and M4 individuals are 0.50 and 0.53. Approximately the same values were obtained by Nagy and colleagues (2008)[39] when they investigated tuberculosis infected individuals from five Hungarian necropolises.

In order to obtain a reliable diagnostic, the presence of *Mycobacterium tuberculosis* ancient-DNA in our samples will be further examined through molecular techniques.

Conclusions

Diagnosing pathological changes in archaeological populations is a highly complicated process[40]. Nowadays, the advancements seen in paleopathological theory and methodology, along with a generalization in the usage of other methods from physics, genetics or biomolecular biology, have increased the validity of differential diagnostics in bioarchaeology. Although DNA analyses can offer confirmation in regard to TB infection, other pathological conditions associated with this condition can be inferred only from the analysis of the skeleton and this is additionally hindered by lack of soft tissue. Still, the two cases presented in this article offer reliable data regarding the diseases to which members of these communities were exposed either through their living environment or as a consequence of their lifestyle and the life-quality levels they were experiencing.

[33] WALDRON 2009,
[34] MARK ET ALII 2009.
[35] TERMINE/POSNER 1966.
[36] MÜLLER ET ALII 2011; BERNA ET ALII 2004.
[37] NAGY ET ALII 2008.
[38] WRIGHT/SCHWARTZ 1996.
[39] NAGY ET ALII 2008.
[40] PINHASI/BOURBOU 2008, 34–35; ORTNER 2008, 192.

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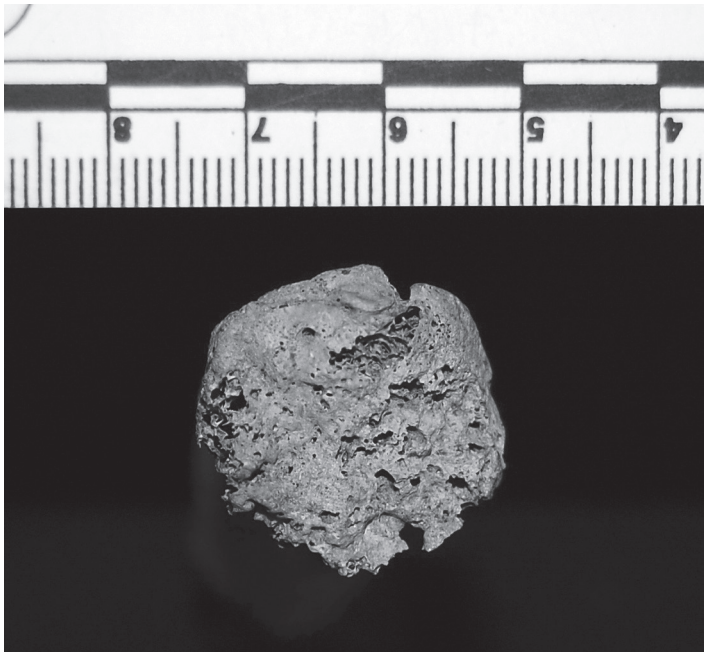

Fig. 1. Sternoclavicular articulation of individual M3. Note the marked erosion of the subchondral bone.

Fig. 2. Left humerus of individual M3. The white arrow indicates marginal lipping along the humeral head.

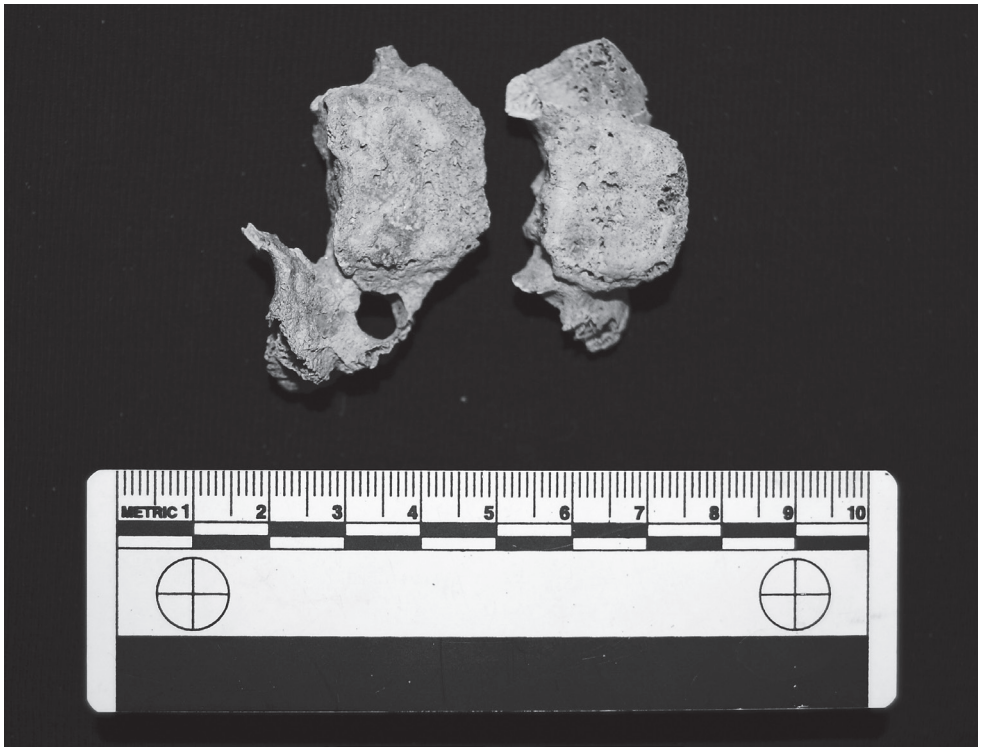

Fig. 3. Two cervical vertebrae from individual M3. Note the marked porosity present on the end-plates of both vertebrae.

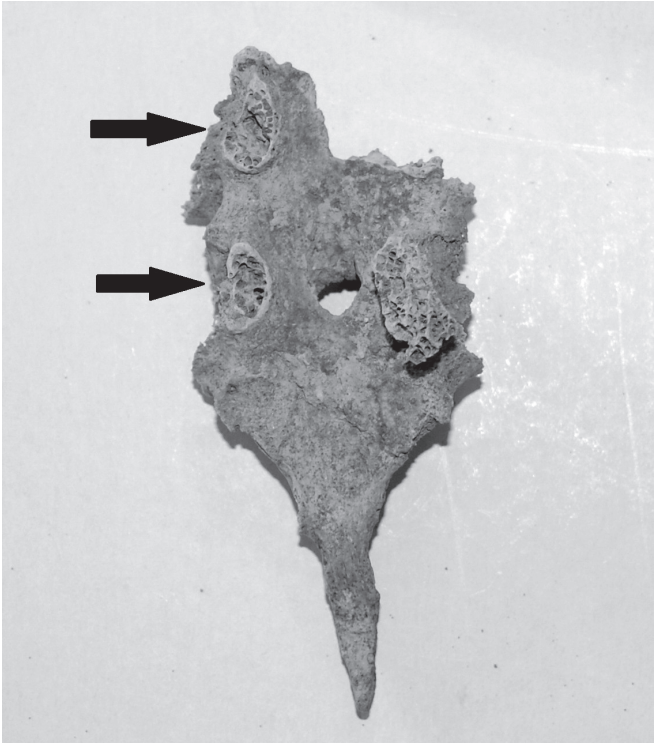

Fig. 4. Apophyses from two thoracic vertebrae showing posterior ankylosis, M3.

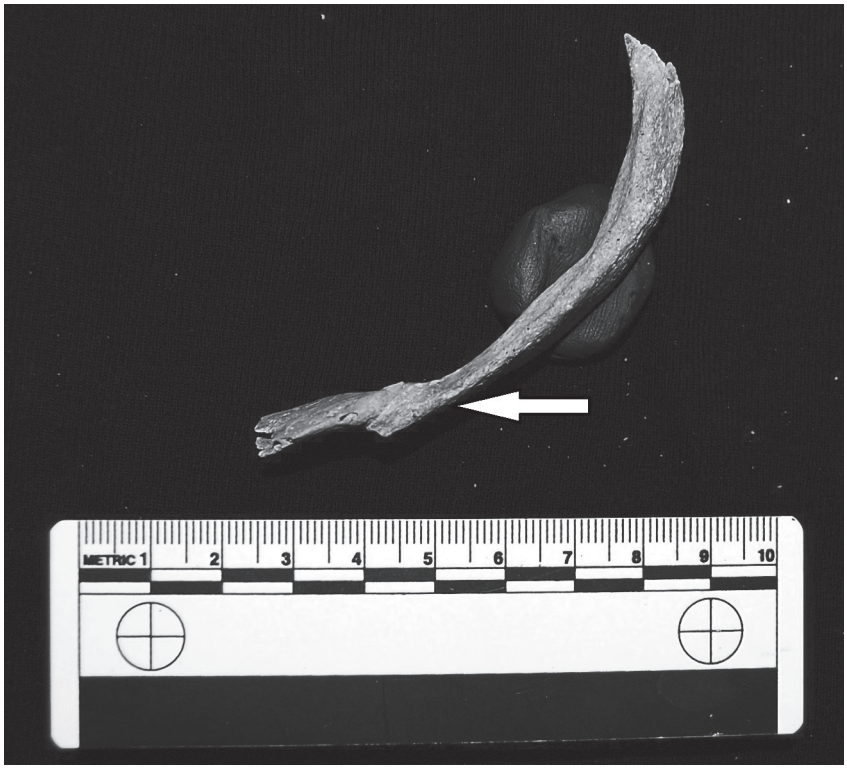

Fig. 5. A rib from individual M3 showing a healead fracture (arrow).

Fig. 6. Two thoracic vertebrae from individual M4 showing anterior ankylosis and osseous destruction on the anterior side of the vertebral body.

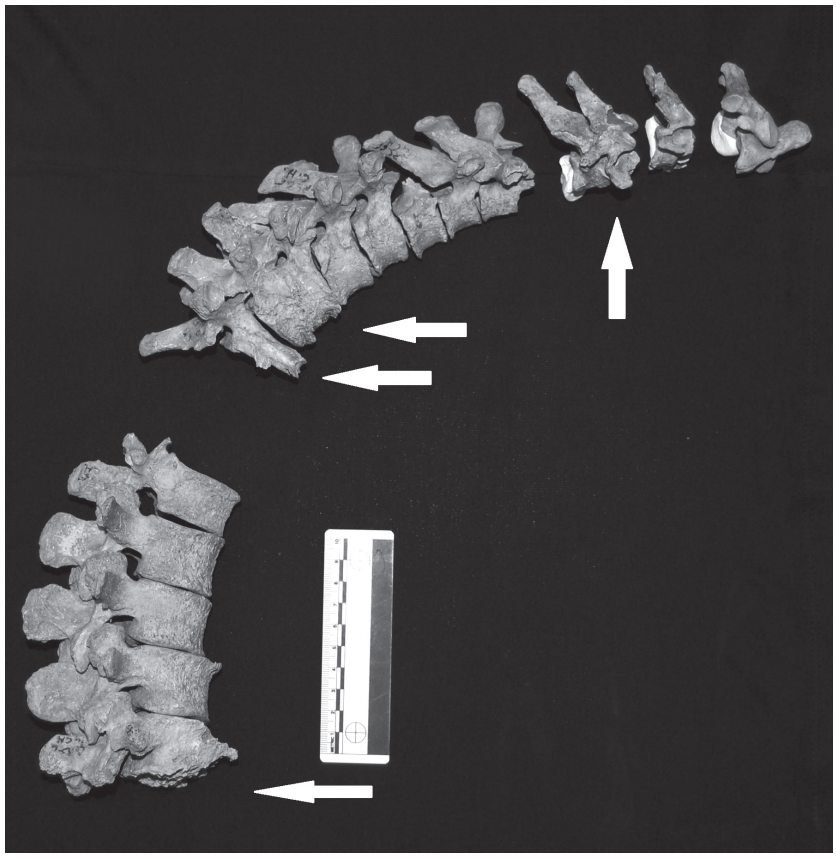

Fig. 7. Reconstruction of the spinal column of individual M4 (two fused thoracic vertebrae are missing from this image) showing marked kyphosis. The arrows indicate the vertebrae showing pathological changes.

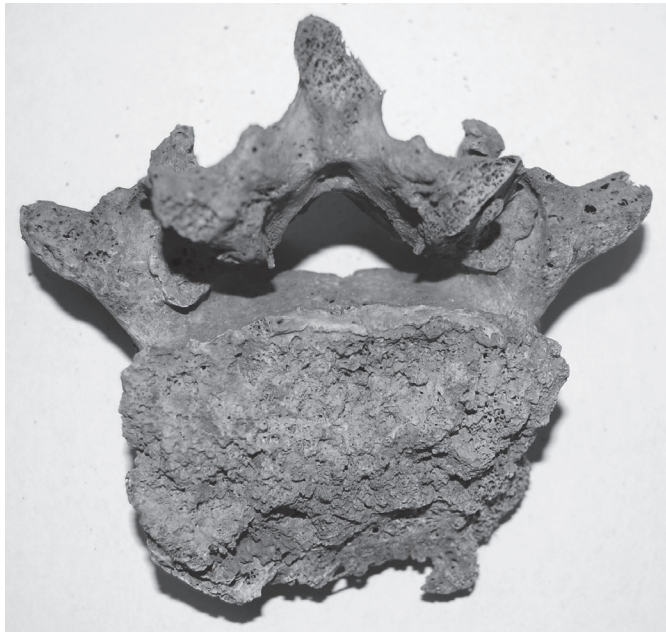

Fig. 8. The inferior end-plate of the L4 vertebra belonging to individual M4. Note the marked destruction of the end-plate.

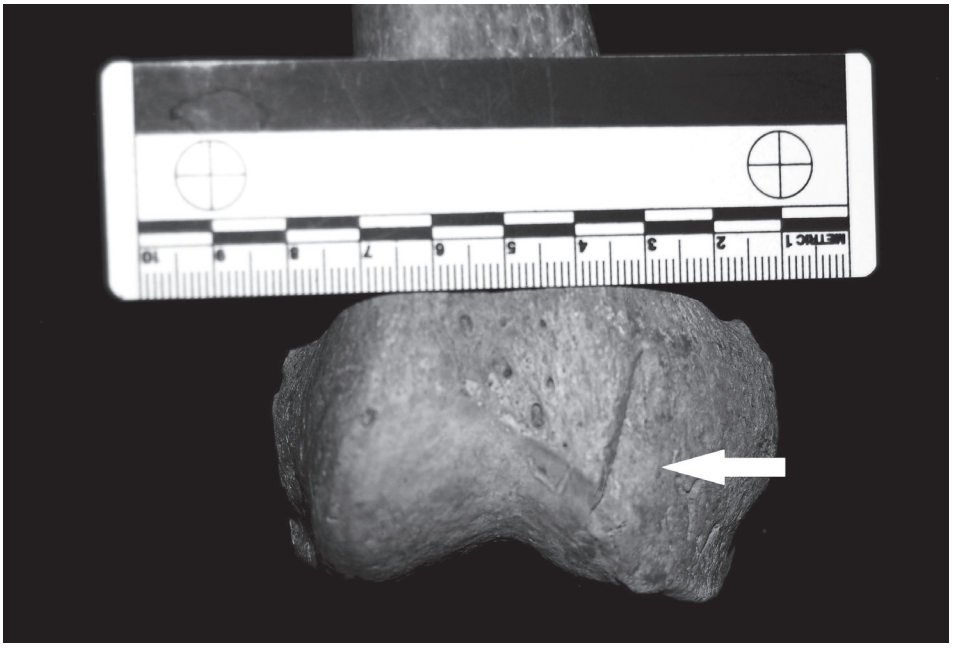

Fig. 9. Trauma on the right distal femur of individual M4 (arrow).

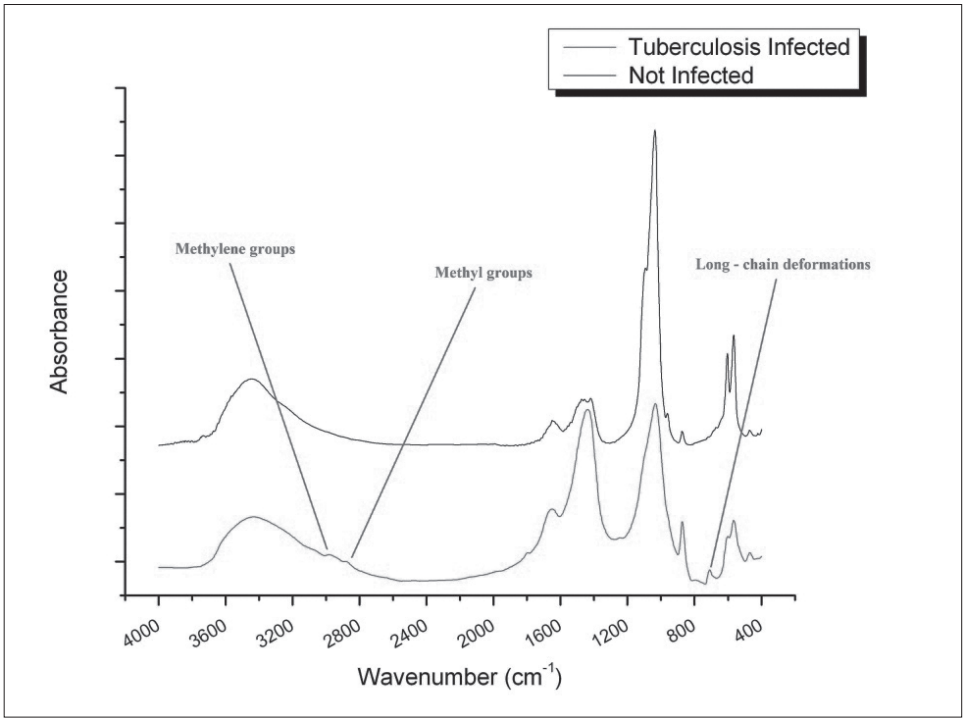

Fig 10. Comparison between spectra of a healthy individual versus Gherăseni M3.