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STUDIA ARCHAEOLOGICA

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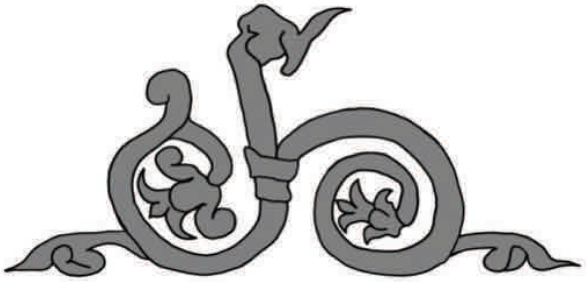

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2014

Editura MEGA
Cluj-Napoca
2014

MUSEUM ARAD

In Romania, the periodical can be obtained through subscription or exchange, sent as post shipment, from Museum Arad, Arad, Piata G. Enescu 1, 310131, Romania.
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ISSN-L 1224–7316

Editura Mega | www.edituramega.ro
e-mail: mega@edituramega.ro

Contents

Musculoskeletal Markers as Evidence of Physical Activity and Social Differentiation in the Lower Mureş Valley during the Late Bronze Age*

Luminița Andreica

Abstract: The present analysis focuses on the identification of occupational stress markers on the skeletons of four individuals discovered in a late Bronze Age necropolis. The importance of the study resides in the attempt to corroborate the osteological proofs with the funerary inventory, in order to formulate certain hypotheses on the status and main activities of these individuals.

Keywords: occupational stress markers, late Bronze Age, physical activity, social category, weapons.

Introduction

The osteological material has been recovered during rescue excavations performed along the route of the Arad-Nădlac highway, in 2011. From this necropolis, labeled Pecica "Site 14", specialists have recovered 23 inhumation tombs and 14 incineration tombs; from a chronological perspective, on the basis of the funerary inventory, archaeologists have estimated that the inhumation tombs can be dated to the late Bronze Age, more precisely to stage Bz B2-C[1].

The main aim of this study is to attempt to identify the presence of warriors among the individuals recovered from the inhumation necropolis. During the last decades anthropologists have managed to reconstruct various aspects from the daily life of people from the past, on the basis of occupational stress markers[2]. The morphology and size of the long bones can be good indicators of prolonged physical activities. The bone development process is sensitive to outer mechanical forces that can lead to the remodeling of the bone tissue, especially in the case of repeated movements or intense forces[3]. One must nevertheless note that such bio-pathological observations are in the case under discussion not sufficient in reconstructing daily life, even less in attributing the individuals a certain status, i.e. that of warriors. Most often, social identity is also expressed through the funerary inventory.

Materials and methods

The present study contains the anthropological analysis of just four individuals from the 23 inhumation tombs. The selection criterion was the funerary inventory; in all four cases, the individuals were buried with various weapons[4].

In order to determine gender I turned to the characteristics of the skull[5], while for the post-cranial skeleton I took into consideration the modifications of the coxa[6]. In order to estimate age I employed the synostosis degree of the cranial sutures[7], the evolution of the public symphyses,[8] and the evolution of the auricular surfaces[9].

* English translation: Ana M. Gruia.
1 Sava, Andreica 2013, 52.
2 Lieverse *et al.* 2009, 458.
3 González, Concepción 2004, 15.
4 Sava, Andreica 2013.
5 Buikstra, Ubelaker 1994, 19–21.
6 Buikstra, Ubelaker 1994, 18.
7 White, Folkens 2005, 369–370.
8 White, Folkens 2005, 374–379.
9 White, Folkens 2005, 380–383.

In the diagnosis and identification of the bone pathology I followed the recommendations in E. González, M. Concepción[10], J. G. Vicente, A. M. Morera[11], and A. C. Aufderheide, C. Rodriguez-Martin[12]. From this perspective, three of the individuals (Cx_067, Cx_092, and Cx_098[13]) are remarkable through the presence of some occupational stress markers that feature in specialized literature as enthesopathies. Enthesopathic lesions manifest as irregularities, bone projections or osteophites at the insertion point of muscles, tendons, and ligaments; these modifications are the result of excessive muscular activity and their localization and dimensions on the skeleton can provide clues as to the daily activities that involve certain muscles or groups of muscles[14].

Unlike the other three individuals, the pathological picture of Cx_075 consists of certain degenerative modifications, especially on the articulations of the long bones. These afflictions of the articulations are pathological conditions, non-inflammatory, chronic ones, characterized by the loss of the articular cartilage due to direct inter-bone contact at the level of the diarthrodial articulations[15]. The main causes of osteoarthritis are mechanical and most often expressed on the spine, at the level of the hips, and of the knees. One can speak of primary osteoarthritis when it is the result of a combination of factors such as age, gender, mechanical stress, or genetic or secondary predisposition if initiated by trauma or bacterial invasions at the level of the articulation[16]. The stature was calculated according to Pearson's method[17] and the identifications were made according to data obtained by G. Farkas, P. Lipták[18].

Results and discussions

Cx 067. The state of preservation and representation of the skeleton is rather poor; the skull is very fragmented, and from the post-cranial skeleton archaeologists have recovered the bones of the left arm (with partially destroyed epiphyses), while from the right side, only one fragment from the diaphysis of the humerus and that of the radius have been preserved. The ribs and the bones of the scapular belthave not been recovered from the lying context and only two lumbar vertebrae have survived from the spine. The coxa is very fragmented. Only the long bones, lacking the epiphyses, have been preserved from the lower limbs.

The funerary inventory consists of several bronze items and two ceramic vessels. In the area of the forearm, probable the right one, archaeologists have found a dagger and a bronze bracelet; another bronze item is a pin discovered between the left humerus and the mandible[19].

The deceased is a man, aged ca. 40–50 years; the auricular surface was, at the time of death, in the 6th stage of development[20], and the cranial sutures were obliterated to a proportion of 90%[21].

Due to the precarious state of preservation of the long bones, the stature could not be calculated.

The left humerus shows accented enthesopathy at the insertion point of the *Pectoralis major* muscle and at the level of the *Deltoid* muscle (Fig. 1/1).

The *Pectoralis major* muscle is involve in rotation and abduction movements, with the bending of the arm[22]. The development of the deltoid tuberosity can be explained as a response of the boneto constant exercise that involved circular and abduction movements of the arms above the head[23] and pushing of the arms towards the chest (medial rotation.)[24] Among the aboriginal population in the

10 González, Concepción 2004.
11 Vicente, Morera 2007.
12 Aufderheide, Rodriguez 1998.
13 Skeleton Cx_098 was previously published in Sava, Andreica 2013.
14 Larsen 1997, 188; Campillo 1994.
15 Aufdaheide, Rodriguez-Martin 1998, 93.
16 White, Folkens 2005, 325.
17 Olivier 1960, 263.
18 Farkas, Lipták 1975, 253–254.
19 Sava, Ignat 2014.
20 White, Folkens 2005, 383.
21 White, Folkens 2005, 370.
22 González, Concepción 2004, 186; Lieverse *et al.* 2009, 468.
23 González, Concepción 2004, 189.
24 Lieverse *et al.* 2009, 468.

Canary Islands for example, this pathological condition has been associated to the repeated use of a weapon called "banot" that involved the throwing of stones. At the same time, these modifications at the level of the *Deltoid* muscle are not only the result of a repeated throwing action, but can also appear through the use of some weapon during hand-to-hand combat, but also through domestic activities and animal husbandry[25].

Fig. 1. 1.Example of strong *Pectoralis major* and *Deltoid* muscle attachment on the left humerus; 2. A left radius with marked *Tuberositas radii*; 3. Left radius with a moderately robust expression at the interosseous membrane.

On the left radius, the bicipital tuberosity (the insertion place of the *Biceps Brachii* muscle) is in the second degree of development[26] (Fig. 1/2). Dutour[27] has associated this enthesopathy with the use of the bow and arrows, an activity during which the elbow is continuously flexed.

A moderately robust expression is visible at the level of the interosseous membrane (Fig. 1/3). The explanation of this modification is not very clear, but specialists presume that it might be the result of a repeated movement of prono-supination of the forearm, as, for example, while transporting certain weights, either with the arms extended or with the arms bent[28].

The left ulna is characterized by the presence of some modifications of the osseous tissue at the insertion place of the *Brachialis* (Fig. 2/1) and *Supinator* muscles.

The *Brachialis* and *Biceps brachii* are the main muscles involved in the flexion and extension of the elbow[29]. After studying a nomad population in southern Asia, Kennedy (1983) has associated the overdevelopment of the supinator crest, on the ulna, with the use of launching weapons, such as spears and boomerangs[30], while González and Concepción have associated this enthesopathy with the throwing of stones[31].

[25] González, Concepción 2004, 190.
[26] Vicente, Morera 2007, 4.
[27] Dutour 1986.
[28] González, Concepción 2004, 197.
[29] Lieverse *et al.* 2009, 469; Dutour 1986, 222.
[30] Larsen 1997, 189.
[31] González, Concepción 2004, 195.

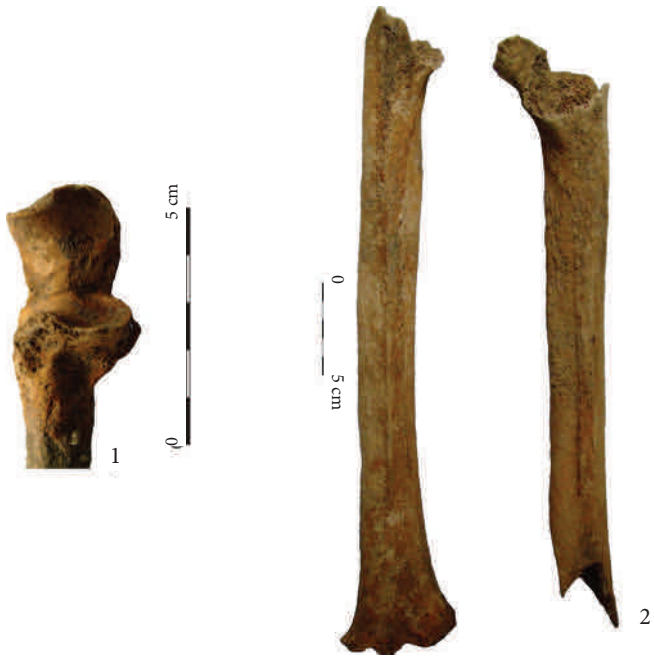


Fig. 2. 1. Example of moderate *Brachialis* muscle attachment on the left ulna; 2. Rough line marked on both femurs.

The rough line of the femurs is marked (Fig. 2/2); this modification has been attributed to a pressure exerted on a muscular mass as a result of posture habits, such as crouching or maintaining the body in a vertical, straight position[32].

On the vertebrae (one thoracic and one lumbar) one can note exostosis collars, both on the upper and lower margins. The body of the lumbar vertebra is strongly subsided (Fig. 3/1; Fig. 3/2). Such degenerative modifications can be, in the present case, related to the individual's age and his performing intense physical activity throughout his life[33].

Fig. 3.1–2. Osteophyte development of vertebral bodies.

Cx 075.Poor state of preservation and representation; the skull cap is very fragmented and could not be reconstructed. The viscerocranium is represented by the mandible and one fragment from the right upper jaw. From the post-cranial skeleton, the long bones are the best preserved (only the distal diaphysis of the right tibia is missing). Thescapular belt and the bones of the thoracic cage are very fragmented; only four lumbar vertebrae and several thoracic and cervical vertebrae were recovered from the spine.

In this case, the funerary inventory is rather poor; the individual was interred just with a bronze dagger[34].

[32] González, Concepción 2004, 293.
[33] Larsen 1997, 163;
[34] Sava, Ignat 2014.

The skeleton belonged, undoubtedly, to a male individual, a fact confirmed by both the characters of the skull[35] and those of the post-cranial skeleton[36]. The surface of the pubic symphysis[37] and the auricular surface[38], at the level of the coxa, indicate an approximate age of 35–45 years.

The 163.8 cm stature was calculated on the basis of the maximum length of the right femur and of the tibia on the left side[39]; this can be estimated at the upper margin of stature for the period under discussion[40].

The pathology of this individual leans towards modifications at the level of bone articulations. Signs of osteoarthrosis have been noted at the level of the articular facets of the axis with the atlas, with eburnation on the right side of the articular surface, with the condyle of the occipital (Fig. 4/1); in sports medicine, it is explained as the result of sudden, repeated movements of the head[41].

On the long bones, at both proximal epiphyses of the ulnas, one notes arthrosic deformations at the level of the large sigmoid cavity (Fig. 4/2); such modifications have been noted both on the femoral condyles and the proximal epiphyses of the tibias.

The primary factor that contributes to the onset of osteoarthritis is mechanical stress and physical activity. Some activities that involve manual labor, such as in the case of farmers, ballet dancers, various types of athletes, and persons performing rigorous physical exercise can trigger such modifications at the level of the articulations[42]; knee arthrosis can be the result of prolonged, frequent walking[43].

Both radii show a moderately robust expression at the level of the insertion of the *Biceps brachii* muscle (Fig. 4/3).

Fig. 4. 1. Osteoarthritis and eburnation on the articular surface of the axis; 2. Osteoarthritis in the cavity sigmoid of the left ulna; 3. Marked *Tuberositas radii* on both radii.

Cx 092. In this case as well, the conservation and representation state of the skeleton is rather poor; the skull is fragmented; the upper limbs are represented by the humerus on the right side and

35 Buikstra, Ubelaker 1994, 19–21.
36 Buikstra, Ubelaker 1994, 18.
37 White, Folkens 2005, 374–379.
38 White, Folkens 2005, 380–383.
39 Olivier 1960, 263.
40 Farkas, Lipták 1975, 253–254.
41 González, Concepción 2004, 247.
42 Larsen 1997, 163–164.
43 González, Concepción 2004, 336.

diaphysis fragments from the humerus on the left side. Out of the forearm bones, only the right radius, one diaphysis fragment from the left radius, the upper half of the right ulna, and the left ulna (missing the distal diaphysis) have been recovered. The ribs are missing and from the spine archaeologists have recovered the lumbar vertebrae (with some destruction), but also a few fragments of the thoracic vertebrae. The pelvic belt is represented by the two coxa, that miss the iliac wings, and the pubic bone, while just the right clavicle was recovered from the scapular belt. The two femurs were recovered from the bones of the lower limbs –the right femur misses the distal epiphysis, while the left shows destructions at the level of both epihyses. The tibias are partially destroyed, especially at the level of the proximal diaphyses. The fibulae have been recovered, but are very fragmented. Some of the bones of the feet were also recovered from the lying context.

The funerary inventory is rather rich, as the following items have been recovered from the lying context: a bronze axe discovered by the right scapula, a pin found parallel to the jaw, and a significant quantity of animal bones was found in the area of the lower limbs. Several pottery fragments, possibly from two vessels, were identified near the skull[44].

This is the skeleton of a male individual; the supraorbital arches are is stage 4 and the menton in stage 3[45]; at the level of the coxa, the greater sciatic notch is of the third degree and the composite arch is almost impossible to see[46]. As for the individual's age, very few indicators have been preserved: according to the auricular surface[47] he died around 40–44 years of age, and the endocranial sutures are not closed[48].

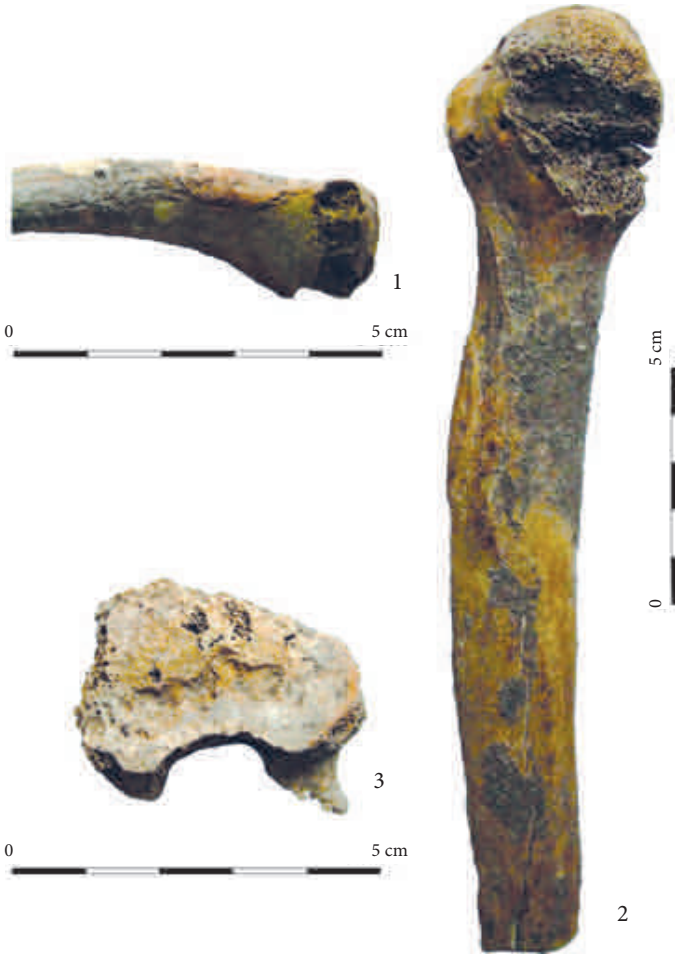


Fig. 5. 1. Marked impression of costoclavicular ligament attachment; 2. Example of strong *Pectoralis major* and *Deltoid* muscle attachment on the right humerus; 3. Thoracic vertebra with Schmorl´s node.

44 Sava, Ignat 2014.
45 Buikstra, Ubelaker 1994, 19–21.
46 Buikstra, Ubelaker 1994, 18.
47 White, Folkens 2005, 380–383.
48 White, Folkens 2005, 369–370.

The absence of the epiphyses of the long bones prevented the calculation of the stature.

The individual displays enthesopaties on the clavicle, at the level of the rib impression (Fig. 5/1). The costoclavicular ligament stabilizes and consolidates the articulation of the clavicle with the first rib during energetic movements of the arms[49].

On the right humerus one notes the arching of the diaphysis, with modifications of the bone on the insertion point of the *Deltoid*and*Pectoralis major*muscles (Fig. 5/2).

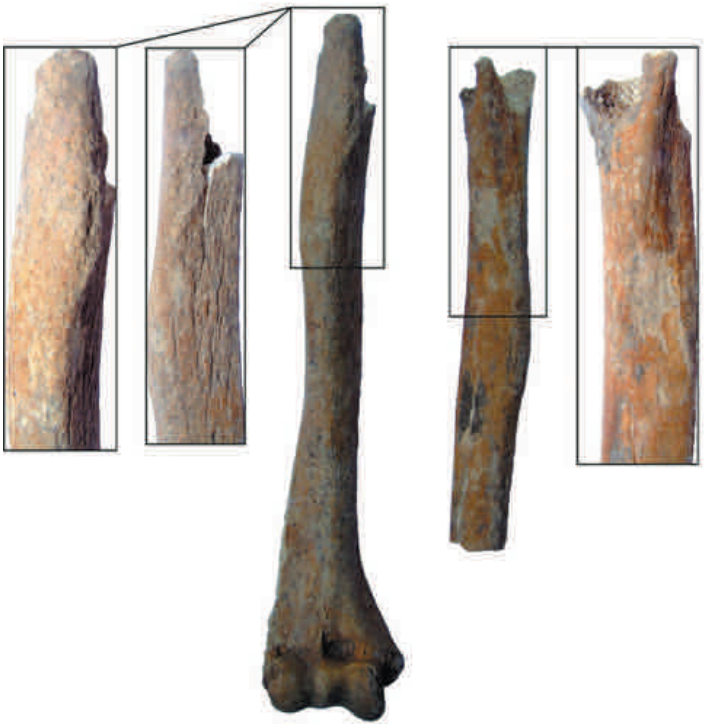
On both radii, the bicipital tuberosity is in stage 3[50], while the rough line of both femurs is marked.

In this case as well the presence of enthesopathiesof the upper limbs suggests activities that involved repeated movements of arm rotation and abduction[51].

Arthrosis modifications have been recorded on the sternal end of the clavicle, at the level of the proximal epiphyses of the ulnas, the right radius, and the distal epiphyses of the tibias. Taking into consideration the degree of development of the enthesopathies, one can presume that these signs of osteoarthrosis are rather the result of intense physical activity. Schmorl nodules can be observed on the thoracic vertebrae (Fig. 5/3). This pathology can be the result of physical exercise involving the flexion and bending of the spine, but might also originate in traumas caused during weight lifting[52].

Cx_098[53]. The skeleton is in a rather poor state of preservation and representation, mainly the scapular belt, the pelvic belt, and the bones of the thorax. Fragments from the frontal and left parietal have been recovered from the skull and just the left side of the mandible and the left zygoma were recovered from the viscerocranium.

The funerary inventory consisted of two bracelets, one pin, and one dagger (all made of bronze), animal bones and pottery vessels placed at the individual's feet[54].



1 2

Fig. 6. 1. The presence of enthesopathies on the right humerus; 2. The presence of enthesopathies on the left humerus.

[49] Lieverse *et al.* 2009, 468.
[50] Vicente, Morera 2007, 4.
[51] González, Concepción 2004, 186.
[52] González, Concepción 2004, 259.
[53] Sava, Andreica 2013.
[54] Sava, Ignat 2014.

Both the cranial and postcranial characters indicate, beyond doubt, that the individual was male[55]. The auricular surface of the ilium suggests that he died at 35–39 years of age[56].

In order to calculate stature, it was only possible to size the maximum length of the left tibia, the only long bone completely preserved; using Pearson's formulae (1960) I have calculated a stature of 169.1 cm. that can be considered large for the period under discussion[57].

As for the presence of enthesopathies on the bones, the case of this individual is very similar to that of Cx_067 and Cx_092; enthesopathies have been identified at the insertion point of the *Deltoid*, *Pectoralis major*, and *Latissimus dorsi* muscles on the humerus (Fig. 6/1, 2), while on the forearms, due to the poor state of preservation of the epiphyses, osteoarthritis could only be observed at the level of the distal epiphysis of the radius. Osteoarthrotic modifications have also been identified at the level of the articulation of the knee.

The fact that this individual performed rather intense physical effort during his life is also attested by the formation of Schmorl nodules on the superior and inferior surface of the lumbar vertebrae.

Conclusions

As previously mentioned, occupational stress markers on the bones are good indicators of prolonged physical activity. But, for as correct as possible an interpretation of the type of activity performed, one needs to corroborate biopathological data with archaeological information.

The preliminary anthropological analysis has allowed for the identification of two main aspects: marked modifications of the bone on the place of muscle and ligament insertion were only noted among male individuals and only on a reduced number of skeletons.

Furthermore, out of the 23 inhumation tombs, these four individuals were different through a richer funerary inventory and, especially, through their burial with various weapons.

A very similar case is that of skeletons from the Bronze Age discovered in Toppo Daguzzo and Madonna di Loreto, that mostly presented the same occupational stress markers on the bones. As in the case under discussion, such modifications were only identified among male individuals and only on a restricted number of persons. There are also similarities in the nature of the funerary inventories; it was only males with marked enthesopathies on the bones who were buried with weapons. Canci[58] is of the opinion that all these observations are proof of the existence, during that period, of a special status for a certain category of individuals, possibly that of warriors.

The general robustness of the bones, the high-level stature, marked enthesopathies on the surface of the bones, besides the archaeological proofs, can lead to the following conclusions: three of the individuals discovered in Pecica (Cx_067, Cx_092, and Cx_098) were part of a special social category inside the community and performed intense physical activity during their life. Similarly to the skeletons found in Italy, it is not far-fetched to presume that they belonged to a group of warriors.

The case of Cx_075 is atypical; despite the fact that he was buried with a bronze dagger, he does not display these enthesopathies on the bones. He might have belonged to a different social category than the other three individuals.

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[55] Buikstra, Ubelaker 1994, 18, 19–21.
[56] White, Folkens 2005, 380–383.
[57] Farkas, Lipták 1975, 253–254.
[58] Canci 1998.

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White, Folkens 2005	T. White, P. Folkens, *The human bone manual*. California 2005.

Abbreviations

ActaArchHung	Acta Archaeologica Academiae Scientiarum Hungaricae. Budapest.
ActaHist	Acta Historica. Szeged.
Acta Siculica	Acta Siculica. Sfântu Gheorghe.
Aluta	Aluta. Revista Muzeului Național Secuiesc Sfântu Gheorghe.
Alba Regia	Alba Regia. Annales Musei Stephani Regis. Székesfehérvár.
AMN	Acta Musei Napocensis. Cluj-Napoca.
AMP	Acta Musei Porolissensis. Muzeul Judeţean de Istorie şi Artă Zalău. Zalău.
ATS	Acta Terrae Septemcastrensis. Sibiu.
AISC	Anuarul Institutului de studii clasice Cluj Napoca. Cluj-Napoca.
AnB S.N.	Analele Banatului – serie nouă. Timişoara.
Apulum	Apulum. Alba-Iulia.
AÉ	Archaeologiai Értesitõ. Budapest.
Areopolisz	Areopolisz. Történelmi- és társadalomtudományi tanulmányok Odorheiu Secuiesc / Székelyudvarhely.
ArhMed	Arheologia Medievală. Iași.
ArchRozhl	Archeologické Rozhledy. Praga.
ArhVest	Arheološki Vestnik. Ljubljana.
Banatica	Banatica. Muzeul Banatului Montan. Reșița.
BHAUT	Bibliotheca Historica et Archaeologica Universitatis Timisiensis.
BAR International Series	British Archaeological Reports, International Series. Oxford.
BAM	Brukenthal Acta Musei. Sibiu.
BMMK	A Békés Megyei múzeumok közleményei, Békéscsába.
CAH	Communicationes Archaeologicae Hungariae. Budapest.
Cerc. Arh.	Cercetări Arheologice. Bucureşti.
CIL	Corpus Inscriptionum Latinarum.
CIMRM	Corpus Inscriptionum et Monumentorum Religionis Mithriacae.
CCA	Cronica Cercetărilor arheologice din România. Bucureşti.
Crisia	Crisia, Muzeul Ţării Crişurilor. Oradea.
Dacia N.S.	Dacia. Recherches et Découvertes Archéologiques en Roumanie, Bucureşti; seria nouă (N.S.): Dacia. Revue d'Archéologie et d'Histoire Ancienne. Bucureşti.
DissArch	Dissertationis Archaelogicae (Budapest).
Dolg	Dolgozatok. Szeged.
EphNap	Ephemeris Napocensis. Cluj-Napoca.
EL	Erdővidéki Lapok. Barót/Baraolt.
EM	Erdélyi Múzeum. Kolozsvár/Cluj-Napoca.
Isis	Isis. Erdélyi Magyar Restaurátor Füzetek. Cluj-Napoca / Kolozsvár.
JbRGZM	Jahrbuch des Römisch-Germanischen Ztentralmuseums Mainz. Mainz.
Marisia	Marisia. Studii și materiale. Arheologie – Istorie – Etnografie. Târgu-Mureș.
MCA	Materiale şi Cercetări Arheologice. București.

MFMÉ StudArch	A Móra Ferenc Múzeum Évkönyve. Studia Archaeologica. Szeged.
MFMÉ MonArch	A Móra Ferenc Múzeum Évkönyve. Monumenta Archeologica. Szeged.
OpArch	Opvscvla Archaeologica. Zagreb.
OpHung	Opuscula Hungarica. Budapest.
Pontica	Pontica, Constanţa.
PZ	Prähistorische Zeitschrift. Berlin.
RMM-MIA	Revista Muzeelor și Monumentelor – seria Monumente Istorice și de Artă. București.
Sargeția NS	*Sargeția NS. Deva.*
SlovArch	*Slovenská Archeológia. Nitra.*
Soproni Szemle	Soproni Szemle kulturtörténeti folyóirat. Sopron.
StudCom	Studia Comitatensia. Tanulmányok Pest megye múzeumaiból. Szentendre.
ŠtudZvesti	Študijne Zvesti Arheologického Ústavu Slovenskej Akademie Vied. Nitra.
Stud. şi Cerc. Num.	Studii şi Cercetări de Istorie Veche şi Arheologie. Bucureşti.
SCIVA	Studii şi Cercetări de Istorie Veche (şi Arheologie). Bucureşti.
StComSatuMare	Studii şi Comunicări. Satu Mare.
Thraco-Dacica	Thraco-Dacica. Bucureşti.
VMMK	A Veszprém megyei Múzeumok Közleményei. Veszprém.
VTT	Veszprémi Történelmi Tár. Veszprém.
Ziridava	Ziridava, Complexul Muzeal Arad. Arad.