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Studies

ARCHAEOLOGICAL MATERIAL AND REPORTS

FRAGMENTS OF A SECOND AVAR HORSE DISCOVERED IN SÂNCRAIU DE MUREȘ AN ARCHAEOZOOLOGICAL REPORT

Abstract: The material presented was in a decent state of conservation, allowing, in most cases, only partial measurements. The material belonged to one single horse (*Equus caballus*), which was evaluated from an anatomical perspective and an osteometrical as well. According to the concluded data, the bones belonged to a young individual, no more than 2-2.5 years old, with an average height calculated, based on the measured long bones, of 135 cm. The gracility indices point to a medium- slender individual. Comparative data from a few Avar period discoveries in the territory of Romania, Hungary and Croatia allow a much larger perspective on the morphology of the identified individuals.

Keywords: archeozoology, horse, osteometry, Avar, animals

INTRODUCTION. HISTORICAL DATA AND CONTEXT

Archaeozoology plays an important role in the reconstruction of past life. Speciality studies stress the importance of the fauna in the development and life of past human populations. A significant part of their life's everyday activity gravitated around animal breeding, regardless of their main occupation- warriors, agriculturers, craftsmen etc. On the other hand, the data obtained by the study of skeletal remains of antique animals may provide significant information about the microevolution of animal populations and specific local or regional features of different species. More than that, some may indirectly provide data on human population migratory patterns and movements in different historical periods^{1,2,3,4}.

SOURCE OF MATERIAL. CHRONOLOGY DATA

Between 2016 and 2021, a series of archaeological diggings were performed in the flat cemetery (dated second half of the VII-th – first half of the VIII-th century AD) from Sâncraiu village. The site is located in the area known as “La Cioca”, between Sâncraiu village-Andrei Mureșan Street and “Ciumbrud Bokk-Pista”.

¹ BOESSNEK *et alii* 1971.

² EL SUSI 1996.

³ POPOVICI *et alii* 2002.

⁴ BINDEA 2005.

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Fig. 1. The horse remains in situ

The cemetery is located on the left bank of the Mureș River, on the first terrace. 110 graves were investigated, arranged in four groups. From an ethno-cultural point of view, the cemetery belongs to the Avar culture of the Carpathian basin⁵. In the spring of 2021, in the middle of an area unaffected by human burials, the tomb of a horse was discovered. This archaeological complex appeared at a depth of 1.10 m, in a conical-rectangular pit with rounded corners, with a filling layer of black soil. The tomb was NW-SE orientated, with the cephalic extremity of the skeleton facing southwest and feet tucked under its belly. The horse tomb contained no other archaeological material. This tomb is quite similar to the Avar burials situated right and left from this place, leading to the logical conclusion that this is part of the finds belonging to the Avar community from Sâncraia (Alba County).

MATERIALS AND METHODS

The material was presented to the Laboratory of Comparative Anatomy of the Faculty of Veterinary Medicine Cluj-Napoca, Romania, in a very poor state of conservation. The packages were grouped on anatomical parts, as they were

extracted, but due to exposure to unfavorable soil conditions, the pieces were very frail and subsequently fragmented. This led to a high degree of post-depositing fragmentation, an aspect that made the reconstruction and metrical data collection quite a challenge.

Some of the fragments were anatomically reconstructed with hot glue or acrylic material, while for others, this was almost an impossible task, despite the evident assignment to a specific anatomical piece or another.

After an initial assessment of the fragments, each bag was gently opened, and the bones were displayed on the workbench. A careful flush was performed to remove the soil fragments, followed by a very attentive mechanical cleaning. This was done to reduce to a maximum the mechanical stress on the frail pieces and to be capable of identifying the small fragments that might be lost in the normal washing procedure.

After this initial cleaning, a second phase was initiated. The pieces were carefully placed on absorbing surfaces and left for drying in a controlled environment (laboratory). After a minimum time of 24 hours, the pieces were individually checked again and turned face down to avoid uneven drying. After another 24 hours, we made sure the pieces were completely dried off and reassessed.

⁵ COSMA 2018.



Fig. 2. The Oseous Pieces After Initial Processing And Hardening And Reconstruction

Another stage focused on the possible reconstruction of the fragmented pieces, some being glued back to the main piece. The anatomical assessment focused on the correct identification of the anatomical pieces^{6, 7, 8, 9} and

⁶ HILLSON 1992.

⁷ SCHMID 1972.

⁸ BARONE 1966.

⁹ HANOT/BOCHATON 2018 despite historical sources describing the key role of equids in numerous past societies, their accurate identification on archaeological sites is still problematic, and only few methods have been developed in order to distinguish the bones of horses, donkeys and their hybrids. Moreover, some of the extant published visual macroscopic criteria are considered as possibly unreliable, partly because of the absence of preliminary test on a large sample of modern specimens. In this work, we try to solve these issues by testing a set of macroscopic visual criteria, collected in the literature or newly described, on a comparative sample of 107 modern skeletons of domestic equids. We quantified the reliability of these criteria and found evidence of 26 osteological characters allowing for the identification of between 90% and 100% of the horses and donkeys of our comparative sample. A method to identify the complete or sub-complete skeletons of hybrids is also proposed using combinations of characters observed on several bones. Finally, the defined osteological criteria are observed on a set of archaeological skeletons, coming from antique to modern sites, in order to demonstrate the applicability of our approach to archaeological remains. The use of our methodology on zooarchaeological samples could allow for a better assessment of the presence of donkeys and hybrids in archaeological sites, and thus, could help improve the knowledge of their respective importance and use by human past societies.,"author":{"dropping-particle":"","family":"Hanot","given":"Pauline","non-dropping-particle":"","parse-names":false,"suffix":""},"dropping-particle":"","family":"Bochaton","given":"Corentin","non-dropping-particle":"","parse-names":false,"suffix":""},"container-title":"Journal

the separation of the right and left sides of the body. The measurements were taken in accordance with the standard osteometrical procedures¹⁰, using digital and classical calipers and measuring tape. Tables indicate the OSTEO code used by the standard methodological material¹¹.

RESULTS

Representation of the skeletal fragments

There were several fragments identified, in quite a bad state of preservation. Several measurements were performed, mainly the ones in the area of the articular angle of the identified pieces. Apart from these, 3 fragments

of Archaeological Science","id":"ITEM-1","issued":{"date-parts":["2018","6","1"]},"page":"12-20","publisher":"Elsevier Inc.,"title":"New osteological criteria for the identification of domestic horses, donkeys and their hybrids in archaeological contexts","type":"article-journal","volume":"94"},"uris":["http://www.mendeley.com/documents/?uuid=ca4af48b-c230-3e15-b6ca-4b80447d6994"]},"mendeley":{"formattedCitation":"Hanot & Bochaton 2018","plainTextFormattedCitation":"Hanot & Bochaton 2018","previouslyFormattedCitation":"Hanot & Bochaton 2018"},"properties":{"noteIndex":9},"schema":"https://github.com/citation-style-language/schema/raw/master/csl-citation.json"}.

¹⁰ VON DEN DRIESCH 1976.

¹¹ DESSE/CHAIX/ DESSE-BERSET 1986.

SKELETAL ELEMENT	R	L	Unclear
Scapula	1	1	3
Humerus	1	1, distal third	-
Radius and ulna	1 ulna, 1 radius	1 ulna, 1 radius	1 ulna
Metacarpals (III)	1	1	
Carpals			8
Coxal			16
Femur	1	1	2
Tibia and fibula	1	1	
Tarsals	1 talus	1 talus, 1 astragalus	
Metatarsals (III)	1	1	
Phalanges			4 ph1, 4 ph2, 4 ph3, 3 navicular bone
Sesamoid bones			4
Rudimentary metacarpals and metatarsals			7
Vertebrae			72
Ribs			120
Dentition			(5) I1-I3 lacteal incisors, 1 permanent incisor
UNIDENTIFIED			135

Appendicular skeleton

The scapula

SCAPULA - METRICAL DATA	R	L
4	-	56
5	-	86
6	-	55
7	-	42

(spinous process, scapular blade, glenoidian surface) were also identified, without a clear allotment for one side or another.

Available measurements alone cannot provide important data. The fact that there is an ossified spinous process is an indicator of an individual older than 10-12 months¹².

The humerus

From this part, there is an almost complete left humerus and a distal third of the right one. The left humerus is unossified on its proximal end, while the distal epiphysis is ossified. The same stands for the distal third of the right humerus. This situation is an indicator of an age interval for this individual of more than 18 months but less than 42 months¹³. The collected metrical data is summarized in the nearby table. Based on the single measurement of the length of the left humerus, the recalculation of the height (Kiessewalter) based on the Fig. mentioned by Kokabi¹⁴ provides a value of 1329 mm. This corresponds to the upper limit of class 4 on Vitt's scale¹⁵.

¹² BARONE 1966; UDRESCU/BEJENARU/HRISCU 1999.

¹³ BARONE 1966; UDRESCU/BEJENARU/HRISCU 1999.

¹⁴ KOKABI 1982.

¹⁵ LAUWERIER 1988.

HUMERUS - METRICAL DATA	L	R
1		
2	273	
3	262	-
4	75	-
5	-	-
6	-	32.8
7	75	76
8	72	72

The radius and ulna

From the thoracic zeugopodium, only one single radius fragment is in a good state of preservation, allowing us to reconstruct the bone on its entire. The right radius is unossified on its distal part, an indicator of an animal with an age under 42 months but more than 18 months¹⁶. The left

RADIUS - METRICAL DATA	L	R
11		320
12		313
13		317
15	71	71
14	77	78
16	35	35
17	25	24
18		71.2
19		69.7

¹⁶ UDRESCU/BEJENARU/HRISCU 1999.



Fig. 3. Humerus - Reconstructed

radius has a degraded distal epiphysis, allowing just a limited number of measurements. For the ulna, we identified 3 olecranian fragments- coracoid articular surfaces (1 left and 1 right, but a middle olecranian fragment remained unattributed.). Collected metrical data is illustrated in the following table.

Measurements of the length of the bone allow recalculation of height in accordance with Kieseewalter's formula¹⁷, indicating a value of 1388 mm, framed as class 5 on Vitt's scale¹⁸.

Carpals

Only 8 fragments of carpals were identified. The right limb carpals were identified- *os pisiforme*, *os carpiulnare*, *os carpi intermedium*, *os carpiradiale*. No important conclusions can be drawn from the study of these bone fragments.

¹⁷ BOESSNEK *et alii* 1971.
¹⁸ LAUWERIER 1988.



Fig. 4. The Left Femoral Fragment

Metacarpals

2 complete pieces survived quite well. The main metacarpals were fully ossified, a clear indicator of age over 15 months. Metrical collected data is illustrated in the following table.

Recalculation of the shoulder height, based on the total length of the bones, provides us with the result of 1346, respectively 1358 mm (based on Kieseewalter's formula)¹⁹,

metacarpals - metrical data	R	L
1	210	212
2	203	205
3	204	204
4	44	46
5	33	30
6	32	32
7		
8	22	21
9	46	46
10	35	34

¹⁹ BOESSNEK *et alii* 1971.

an upper limit of class 4 on Vitt's scale²⁰. The calculation of the diaphyseal index (15.23 and 15.09) for the available pieces indicates, by the Brauner scale,²¹ a sub-medium (semi-slender²²) class of individuals or, if we consider the Cersky scale, a medium-slender individual²³, as far as robusticity is concerned.

Pelvis

A total number of 16 fragments were identified. None of them were designated as right or left, but can be grouped into 3 categories: 2 are from the iliac body, with unossified tuberosities, 6 fragments were listed as periacetabular fragments, while the other 8 were listed as diverse ischiatic or iliac fragments. The only data we can extract from these fragments is the age of the individual, situated under 4-5 years²⁴.

Femur

Femur - metrical data	L	R
3	107	106
6	38	
7	45	

A left femur is present as a proximal part and the diaphysis, as its distal part or epiphysis is missing (in fact, the diagenetic fracture occurred at the level of the plantar fossa). For the right piece, only the proximal epiphysis is present and identifiable. Two condylar pieces were also identified, with no clear allotment for one or another side. Some metrical data were collected, as visible in the following table. The fusion data for both femoral pieces indicate an individual who is younger than 36 months²⁵. For the distal condylar pieces, there is a reasonable supposition that they are unossified as well (based on their appearance), an indicator of an age under 42 months^{26,27}.

²⁰ LAUWERIER 1988.

²¹ UDRESCU/BEJENARU/HRISCU 1999.

²² PILIČIAUSKIENĖ *et alii* 2022 which has left about 2000 known horse burials. This paper publishes the osteometric data and age of horses found in Lithuanian cemeteries and castles of the 3rd-14th C AD, over 200 individuals in total. These are the remains of all the horses still stored in Lithuanian institutions. The paper discusses the dynamics of horse body size in order to test previously suggested hypotheses regarding the relationship between large horse body size and its military use, possibly non-local breed, and high social status of the owner. Moreover, we are publishing the AMS14 C dates of 13 horses previously assigned to the Migration period. The research results corrected the existing chronology. The abundant data also allowed an assessment of the development of the size and age of the horses in Lithuania between the 3rd and 14th C AD. Osteometric analyses have shown that Late Roman-post-Migration-period horses were unusually large compared to the Viking and medieval horses in Lithuania. Meanwhile, we suggest that the semi-slender-legged 118-125-cm-tall horse, which predominated in the Viking period, is the most consistent with the local horse type. In general, the horses in Lithuania in the 3rd-11th C AD were small compared to those in Central and Western Europe or Scandinavia. More significant changes can be observed in the Middle Ages. In the 12-14th C AD, there was a much greater variety of horses and the expansion of taller (140-150 cm).

²³ UDRESCU/BEJENARU/HRISCU 1999.

²⁴ UDRESCU/BEJENARU/HRISCU 1999.

²⁵ UDRESCU/BEJENARU/HRISCU 1999.

²⁶ BARONE 1966.

²⁷ UDRESCU/BEJENARU/HRISCU 1999.

Tibia

Both bones were in a decent state of conservation, allowing assessments of the epiphyseal stages and a series of measurements. Based on the distal stage of epiphyseal fusion, one can state that the fragments originate from an individual of an age situated close to 24 months²⁸. Metric data of the entire length of one bone, in accordance with Kieseewalter's formula,²⁹ provides the value of 1482 mm, framing the individual in class 6 in accordance with Vitt's scale³⁰.



Fig. 5. Tibial Fragments, Sesamoid And Rudimentary Metapodials

TIBIA - METRICAL DATA	L	R
1	340	
2	327	
3	86	
4	38	
5	30	
6	66	
7	42	44

Tarsals

	TALUS-R	TALUS-L	ASTRAGALLUS-L
1	101	102	54
2	42	48	

²⁸ UDRESCU/BEJENARU/HRISCU 1999.

²⁹ BOESSNEK *et alii* 1971.

³⁰ LAUWERIER 1988.

For the 2 tali, we took measurements and recorded the status of the tuberosity. This is an indicator of an age below 36 months^{31,32} (unossified). There is also a measurement valid for the astragalus.

Metatarsals

METATARSALS - METRICAL DATA	L	R
1	254	253
2	245	247
3	242	245
4	47	47
5	42	40
6	29	29
7		
8	27	28
9	45	45
10	35	35

The fragments that survived interestingly quite well, allowed assessments of the age and permitted a complete set of metrical data to be collected, as illustrated below.

Based on the observed fusion stages, we can conclude that both bones originate from an individual over 15 months of age^{33,34}. Calculations based on the length available data provided very similar values- 1353 and 1348 mm³⁵, which correlate with an individual listed as class 4 on Vitt's scale (upper limit)³⁶. The gracility indices (11,41 and 11,46), based on Brauner's scale, indicate a slender individual^{37,38}.

Phalanges

PHALANGES - METRICAL DATA	PH1	PH1	PH1	PH1	PH2	PH2	PH2	PH2	PH3	PH3	PH3	PH3
1	75	75	79	78	45	42	43	41				
2	51	49	51	51	45	48	48	49	58	57	56	53
3	33	33	33	34								
4	42	41	43	44	41	45	43	45				

³¹ SCHMID 1972.

³² UDRESCU/BEJENARU/HRISCU 1999.

³³ UDRESCU/BEJENARU/HRISCU 1999.

³⁴ BARONE 1966.

³⁵ BOESSNEK *et alii* 1971.

³⁶ LAUWERIER 1988.

³⁷ UDRESCU/BEJENARU/HRISCU 1999.

³⁸ PILIČIAUSKIENĖ *et alii* 2022 which has left about 2000 known horse burials. This paper publishes the osteometric data and age of horses found in Lithuanian cemeteries and castles of the 3rd-14th C AD, over 200 individuals in total. These are the remains of all the horses still stored in Lithuanian institutions. The paper discusses the dynamics of horse body size in order to test previously suggested hypotheses regarding the relationship between large horse body size and its military use, possibly non-local breed, and high social status of the owner. Moreover, we are publishing the AMS14 C dates of 13 horses previously assigned to the Migration period. The research results corrected the existing chronology. The abundant data also allowed an assessment of the development of the size and age of the horses in Lithuania between the 3rd and 14th C AD. Osteometric analyses have shown that Late Roman-post-Migration-period horses were unusually large compared to the Viking and medieval horses in Lithuania. Meanwhile, we suggest that the semi-slender-legged 118-125-cm-tall horse, which predominated in the Viking period, is the most consistent with the local horse type. In general, the horses in Lithuania in the 3rd-11th C AD were small compared to those in Central and Western Europe or Scandinavia. More significant changes can be observed in the Middle Ages. In the 12-14th C AD, there was a much greater variety of horses and the expansion of taller (140-150 cm.

In this group, we include all phalanges, regardless of their origin from the fore or hindlimb. All fragments are



Fig. 6. Metapodials (Metatarsals-Left, Metacarpals-Right) and Phalanges

ossified, an indicator of the origin of an individual older than 10-15 months³⁹.

Axial skeleton

Vertebrae and ribs

A total number of 72 vertebral fragments were identified. Most of them were thoracal and lumbar pieces, with no evidence of the existence of cervical vertebral pieces. A large number (120) of fragmented ribs was also identified. Based on fusion data of the vertebrae, we can conclude that these pieces originate from an individual that is younger than 4.5-5 years⁴⁰.

Dentition

As for the cranium, only three fragments of dentition were present; the question of how these elements remained here and how the rest of the cranium did not survive on site points to a possible earlier removal of the cranium. Speculations can be made on this issue, but we leave this to the much larger contextualization of the whole find, as

³⁹ BARONE 1966; UDRESCU/BEJENARU/HRISCU 1999.

⁴⁰ UDRESCU/BEJENARU/HRISCU 1999.



Fig. 7. Dentition (Lacteal Incisors-Lower Row)

suggested by fellow archaeologists. What is important is the fact that these three elements of the lacteal dentition and the unerupted definitive incisor provide crucial elements regarding the age of the animal at death, which is situated in a more precise 2-2.5 years.

DISCUSSIONS AND CONCLUSIONS

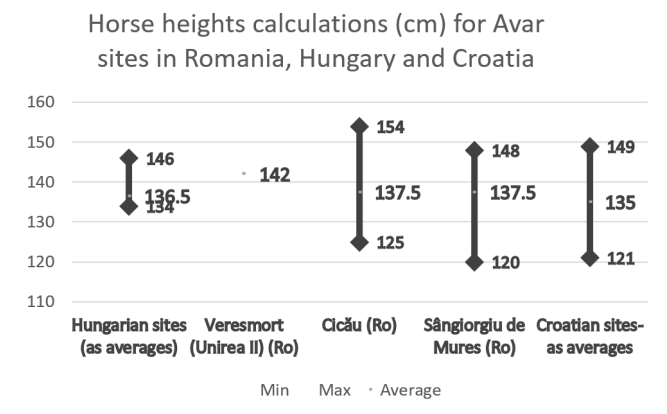
The present study brings into light, to the best of our knowledge, a new series of elements referring to the morphology of the horse from the Avar period, along with other studies of the same period for the area of our country^{41,42,43}. This is why the addition of these data is an important piece of knowledge for the period in terms of animal morphology that results from this study.

Based on the morphological and metrical data we extracted by the study of the skeletal parts, we can conclude that the studied fragments originate from a single young horse individual (*Equus caballus*) that is no older than 2.5 years, more probably with an age situated in the 2-2.5 years age-span.

The multitude of metrical data can help us estimate the shoulder height for our individual, which is situated in the interval of 135-140 cm (1372 mm average calculated value), a value that indicates the lower limit for the group of medium horses⁴⁴.

One must mention the fact that some of the bones were not fully ossified, a thing that leaves some room for interpretation with respect to the degree of the body

development of a young individual such as the one we are invoking here.



Based on the modern zootechnical data, the body size of a 2 years-old yearling will be 96% of the mature weight and body development⁴⁵, thus leaving us to assume that the combined method calculation of the height (that involves only the Gl of humerus, radius and metacarpals with a correction due to inclined axis of the stylopodium- as suggested by Bartosiewicz⁴⁶) is providing with quite accurate final results. With this formula, a final value of 130 cm is resulting (1296 mm). With the added correction of another 4-5% (as implied by zootechnical data), one can assume a value of 137-138 cm based on this calculation method.

The other estimations, which are based on the simple average data provided by the individual calculations of the height of all long appendicular elements, provide an average value of 1372 mm (+/- 25).

Both calculations provide quite similar values, so we can consider both as reliable as far as metrical data are concerned. This includes the identified individual into class 5, by Vitt's scale⁴⁷, with a robusticity index that indicates a semi-slender class of limbs.

The resulting combined morphometrical and age data, integrated into the series of known facts about the Avar horse characteristics for the nearby territories, show a good degree of similitude in terms of heights for the horses discovered on the territory of Romania but also in Hungary^{48,49}, or Croatia⁵⁰. As we can observe from the graph of the heights, the few Romanian sites are not very different with

⁴¹ GUDEA *et alii* 2022.

⁴² GUDEA *et alii* 2008.

⁴³ GEOROCEANU *et alii* 1977.

⁴⁴ JAWORSKI *et alii* 2020 or perhaps there was no difference between the skeletal remains of horses and other species in this regard. For this purpose, statistical calculations on the use of the bones of various mammals were made. Only the remains of the species determined during the archaeozoological analysis were taken into account. The specific use of individual parts of a horse skeleton was also noted. In addition, the analysis also encompasses all other types of horse remains that could be used by humans (hide, hair, etc.).

⁴⁵ ROGERS/GEE/DITTMER 2021 and social media in particular, there is often debate about the age at which a horse should be started and introduced to racing or sport. To optimize the welfare and longevity of horses in racing and sport, it is important to match exercise with musculoskeletal development and the ability of the musculoskeletal system to respond to loading. The justification for not exercising horses at a certain age is often in contrast to the scientific literature and framed, with incorrect generalizations, with human growth. This review provides a relative comparison of the growth and development of the horse to the descriptors used to define growth and development in humans. Measures of physeal closure and somatic growth demonstrate that the horse completes the equivalent of rapid infant growth by weaning (4-6 months old).

⁴⁶ BARTOSIEWICZ 1995.

⁴⁷ LAUWERIER 1988.

⁴⁸ BARTOSIEWICZ 2006.

⁴⁹ BÖKÖNY 1974.

⁵⁰ VUKICEVIC *et alii* 2017 grave 4 at Otok - Gradina (AD 750-840).

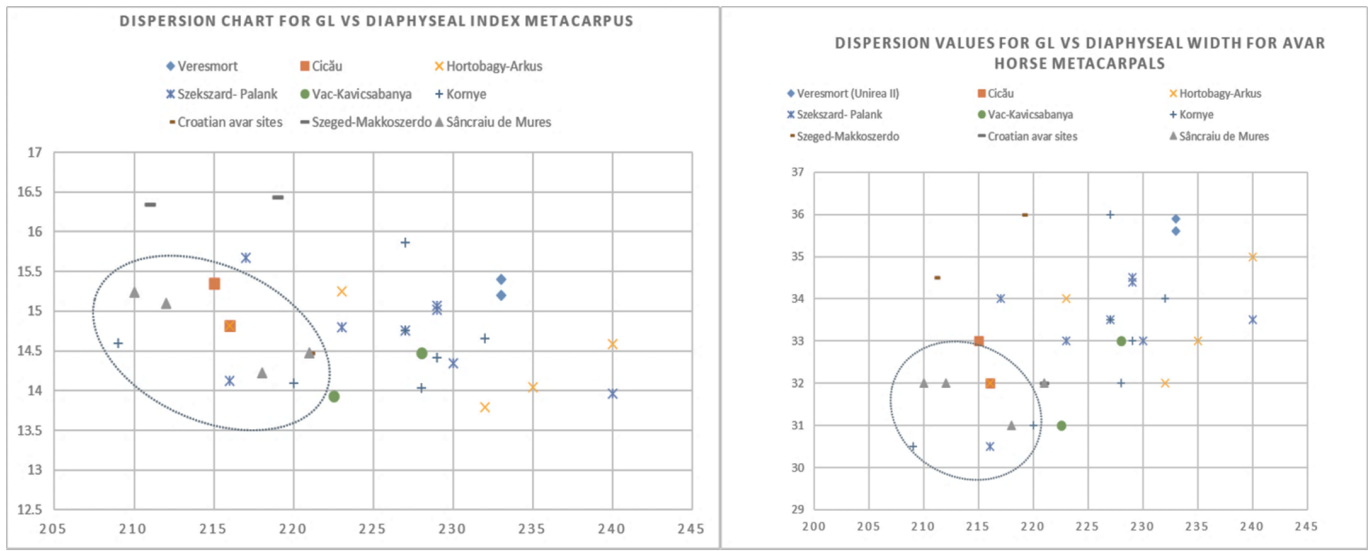


Fig. 8. Dispersion Charts For The Main Metacarpal Measurements

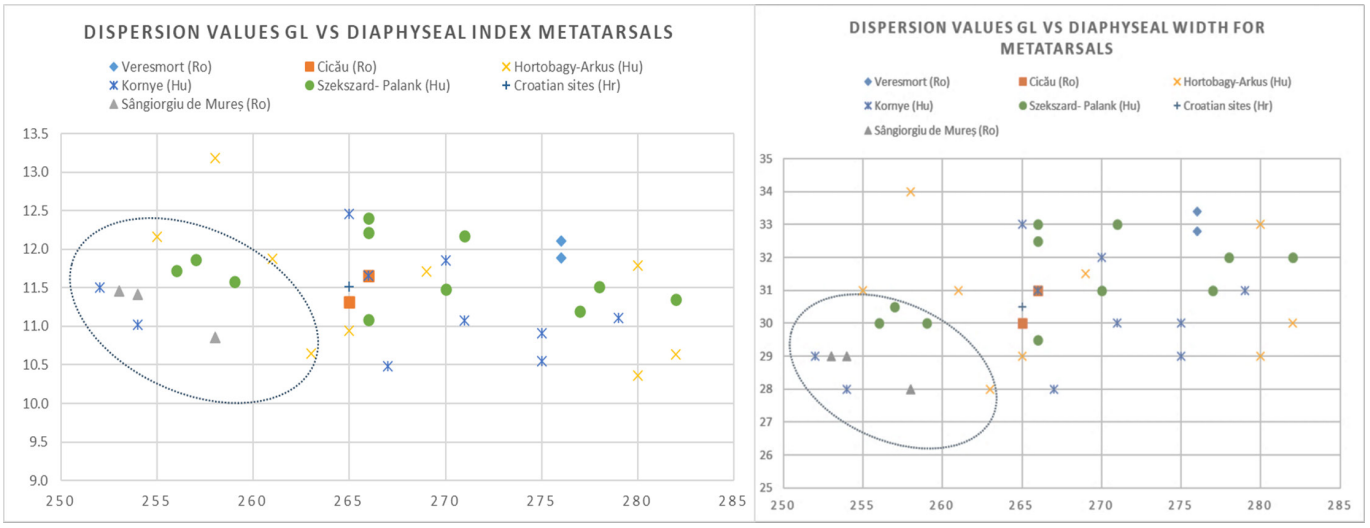


Fig. 9. Dispersion Charts For The Main Metatarsal Measurements

respect to average values. There is a slight variation, but due to the scarcity of the data, very few facts can be inferred based on these data. Another interesting perspective is given by the comparison of some indices and plot graphs for osteometrical data, especially for the metapodials.

As can be observed on the simple dispersion graph for metacarpals (appearing as small triangular surfaces), the data for our individuals seems to be situated in the lower left corner of the graph, in comparison with other sites, with similar Fig.s from some Romanian, Hungarian or Croatian sites.

The dispersion chart that represents the length vs. diaphyseal index points to a similar situation. The values for the Sâncraiu individuals are located in the same lower left part of the graph, but again, with no clear separation from other sets of values from other sites. What seems to stand out a little bit is the set of values from Veresmort, but given the small set of data, no firm conclusions can be drawn.

If we compare the same set of dispersion charts for the Gl vs. index or diaphyseal index in the case of metatarsals, the

same situation appears. The Sâncraiu individuals occupy the low-left registry of the charts, with the Veresmort individual situated in the opposite corner of the chart, but still mingled with various values of sites of Hungary or Croatia.

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