IJAE
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

Firenze University Press
www.fupress.com/ijae

Citation: Rita M. Serra, Paolo Melis, Andrea Montella, Pasquale Bandiera (2022) Bioarcheological and paleopathological study of a multiple deposition burial from S. Antine- Genoni (SU) – Sardegna - Italy. *Italian Journal of Anatomy and Embryology* 126(2): 9-16. doi: 10.36253/ijae-13842

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

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Bioarcheological and paleopathological study of a multiple deposition burial from S. Antine-Genoni (SU) – Sardegna - Italy

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Abstract. A multiple deposition burial in a lithic coffin was found on a hill located in the Campidano valley, in Central South Sardinia (Italy). The site was used from 1800 BC to 500 AD, the burial seems to be dated to the Roman age (238 BC-470AD). A total of 98 human bones and 3 human teeth were present. Anthropological and paleopathological analyses were made. The biological profile was defined with standard anthropological methodologies. The anthropological analysis. A large part of the bones can be referred to as an adult male. Most of the bones display the presence of pathologies, in most cases osteophytosis, the correlation of the same pathologies in contiguous bones indicate that they may belong to the same individual. Very interesting is a possible blade injury in the lateral epicondyle of the right male humerus and a plausible pertrochanteric fracture. The presence, in the same coffin, of a small number of individuals, with the presence of one subadult, can't completely exclude that they were members of the same family group. More analyses will be necessary to better understand the context.

Keywords: Sardinia, anthropology, paleopathology, blade injury.

INTRODUCTION

Sardinia is an island located in the middle of the Mediterranean Sea. Its history started with local people's civilization: two different phases named "Pre-Nuragic" (450.000-1.800 BC) and "Nuragic" (1.800-238 BC) ages (Lilliu G. 2004). Nuragic age gets its name from a truncated cone megalithic structure called "Nuraghe", present all over the island.

From 800 BC, there were many dominions in Sardinia, perhaps due to its position in the middle of the most important trade routes of the past. These dominions were present mostly near the coast, while the middle of the island was interested in the survival of the previous domination.

Phoenicians and Punics (Bartoloni P. et al 1997), and Roman (Angiolillo S. et al 2017), mentioning some of them, settled their village along the Sardinian coast, at the beginning; just later their presence is evidenced also in inland. Historical changes in Sardinia have influenced the native population and civilization and marked the history of the island. A recent study (Marcus J.H. et al 2020) has investigated the genetic history of the island, underling the introduction of new genetic inheritance and the survival of the local population at the same time. Many studies have concerned humans remain in all ages all over the island, evidencing lifestyle, feed, occupational markers, origin, and migration.

The anthropological study provides a better understanding of the evolution and changes of Sardinian civilization. The southern region characterized by the Campidano valley was interested in a more significant presence of eastern dominance than the northern part. That part of the island has, at the present time, a lack of studies and information.

MATERIALS AND METHODS

The site of Genoni is located on a hill, in the Campidano valley, in the middle of Sardinia. The area was used from the Nuragic Age (1800-238 BC) to the Punic (470-238BC) and the Roman Age (238 BC-470 AD), evidenced by the presence of many Nuragic and Roman structures.

One of these structures was a lithic coffin that contained human remains from different people. To understand the real use of the site we decided to study the biological profile of these people, using the main standard anthropological methodologies (Ubelaker D.H. 1989; Perrot R. 2012), supported by newer methodologies when it has been necessary (Catteneo C. et al 2004).

Sex was determined using morphologic methodologies (Açsàdi C.Y, Nemeskéri J. 1970; Phenice T.W. 1969).

To determine the age of death we use standard methodologies (Iscan M.Y. 1984, Lovejoy C.O et al 1985; Meindel R.S., Lovejoy C.O. 1985, Brooks S., Suckey J.M. 1990), also considering the new evaluation of methodology (Verzeletti et al 2010; Russel K.F. et al 1993).

Estimation of stature was based on the Trotter and Glaser methodology (Trotter M., Gleser G.C. 1952) which considered the maximum length of the bone.

To better understand pathological conditions, markers of occupational stress (Henderson C.Y. et al 2013, Mariotti V. et al 2007) and state of health (Fornaciari G., Giuffra V. 2009; Ortner D.J et al 1985) have been studied. All the analyses were done in the paleoanthropology laboratory of the Department of Biomedical Sciences at the University of Sassari.

Pathological conditions are assessed according to traditional classification and divided into bones and anatomical regions. Markers of occupational stress were also considered in the same bones.

RESULTS AND DISCUSSION

We have analyzed an amount of 98 human bones (complete and fragmented) and 3 teeth (Table 1). Most of them are vertebrae and ribs (an amount of 57), and among the other bones, the most present is the right femur (3) and the left pelvis (3).

Starting from the total number of bones, only one person could be present; but they are not only the adult's bones, considering that the minimum number of individuals became two. But to understand the number of individuals it is necessary to consider the biological profile, which was calculated for each bone.

Biological profile

Table 2 presented the division of bones among sex after anthropological analysis.

- Three individuals are computed from the pelvis: one adult male, one adult female and one sub-adult.
- Three individuals of the right femur: 2 adult males and 1 subadult.
- Two individuals occur from most other bones, generally two adults or one adult and one subadult.

To summarize, the anthropological analysis of each bone shows a minimum number of 4 individuals: 2 adult males, 1 adult female and 1 subadult.

For determining the age of death, we used the same methodology. The estimation displayed homogeneity in the distribution; the most diagnostic, as usual, is the pelvis.

Table 3 shows the age range of death for each bone, taking into account their gender determination.

Most of the bones showed an age range "older than", sharper data from ribs. They are referred to two sex indeterminate individuals in the age range of 24/35 Y (YA) and 40/50Y (OA), and a female individual of more than 30Y (MA). Another diagnostic data comes from the pelvic bone of three individuals: a male of 50/59Y (OA), an indeterminate adult of 35/45Y (MA) and a subadult of 4/7Y (INF).

Crossing results of age and sex determination, and considering the minimum number of individuals estimated, apparently present a totality of 4 individuals:

Table 1. Bones present with the number of them. Note: Tooth (FDI number of tooth present); vertebra (C=cervical; T=thoracic; L=lumbar); bones (R=Right; L=Left).

Bone	Com(plete)/ fr(agmentary)	Nr	Note
skull	fr	1	
tooth	com	3	36;37;46
vertebra	com	31	10C;16T;5L
rib	fr	26	10R; 16L;
clavicula	fr	5	3L;2R
sternum	fr	1	
scapula	fr	2	2L
humerus	com/fr	3	1R; 2L
radius	com	1	1L
ulna	fr	3	2L;1R
hand	fr	4	2 1st metacarpal R; 1 proximal phalanges R; 1 2nd metacarpal L
pelvis	fr	3	2 ilium L; 1 acetabulum L
sacrum	fr	2	
femur	com/fr	6	3 com R; 1 com L; 2 fr L
tibia	fr	5	4 L; 1 R
fibula	fr	1	1R
foot	fr	4	1 talus R; 1 talus L; 1 calcaneus L; 1 2nd metatarsal L

Table 2. Division of bones among sex. (M=male; F=female; I=indeterminate; SubAd=Sub-adult; TOT=total).

Anatomical regions	M	F	I	**SubAd**	**TOT**
skull			1		**1**
teeth			1	1	**2**
vertebrae			2		**2**
ribs			2		**2**
clavicle	1	1			**2**
scapula	1	1			**2**
humerus	1	1			**2**
radius	1				**1**
ulna	1		1		**2**
hand			2		**2**
pelvis	1	1		1	**3**
sacrum	1		1		**2**
femur	2			1	**3**
tibia	1		1		**2**
fibula			1		**1**
talus	1	1			**2**
calcaneus			1		**1**
II metatarsal			1		**1**
TOT	**2**	**1**	**2**	**1**	

Table 3. Age range of death for each bone. (M=male; F=female; I=indeterminate; SubAd=Sub-adult).

Anatomical regions	M	F	I	**SubAd**
skull				
teeth				7/8y
vertebrae			>18	
ribs			24/32y; 40/50y	
clavicle	>30y	>30yy		
scapula	>22y	>22y		
humerus	>21y	>21y		
radius	>18y			
ulna	>18y		>18y	
hand			>16y	
pelvis	50/59y		35/45y	3/5y
sacrum	>25y		>25y	
femur	>21y			5/7 y
tibia	>21y		>21y	
fibula			>21y	
talus				
calcaneus			>21y	
II metatarsal			>18y	

- Two adult males, the former in the range of young adults (YA) aged between 25 and 35 years, the latter in the range of middle adults (MA) aged between 35 and 45 years.
- One adult female, in the age range of old adult (OA) aged older than 46 years.
- One subadult aged between 5 and 8 years.

The poor conservation of most bones consented to the stim of stature only in five of them (Table 4).

In three cases the individual was a male, and the stature estimated was 164m, 165cm and 158 cm. Is evident a difference between the average of the the first two compared to the last, but it is also important to remember that there are two adult males individuals.

One stature estimation is referred to as a sub-adult, with a height of 107 cm.

The last estimation, 165cm, comes from a talus of sex-undetermined individuals.

Pathologies

A high percentage of bones show pathological conditions: in a total of 98, 36 (37%) of them were pathologic, all of them related to adult individuals (Figure 1)

More than 80% of the observed pathologies were osteophytosis:

Table 4. Stim of stature in cases where complete bones were present, standardized to Trotter e Gleser method.(m=adult male; I=adult indeterminated; inf= subadult; R=right side; L=left side).

Sex	m	m	m	inf	I
Bone	humerus	radius	femur	femur	talus
Com(plete)/ Fr(agmentary)	com	com	com	fr	com
R/L	R	L	R	R	L
Stature (Trotter & Gleser)	165,314	164,06	158,752	107,344	165,21

- 20 of the 31 vertebrae (5 cervical; 10 thoracic, 3 lumbar, 1 sacral);
- 7 ribs of the 26 (6 from left and 1 from right side);
- 3 clavicles of the 4 (1 from the right; 2 from the left);
- 2 humeri from 3 (1 from the right;1 from the left);
- 2 ulnae from the 3 (from the left);
- 2 femora from 6 (1 from the right 1 from the left).

Considering the bones in which pathologies are present (Table 5), with the presence of two left ulnas and two left clavicles, at least two adults are present but is also true that many of them are ascribable to a male individual.

Very interesting pathological signs occur in the right and left male humerus

The left (Figure 2b; 2d) and right (Figure 2a; 2c) humerus exhibit an abnormal evolution of the distal epiphysis. The lateral epicondyle appears smoother as usual, with the presence of osteophyte lips at the posterior margin.

This abnormality is localized at the origin of the anconeus muscle, an extensor muscle of the forearm inserted in the proximal dorsal epiphysis of the ulna (Figure 2e).

Unfortunately, we have a few presences of forearm bone probably related; only a left proximal ulna, where marked osteophytosis is present.

Another interesting situation is present in the same right humerus. The medial epicondyle of the distal epiphysis has an irregular shape, with an anterior deep groove. Considering the development of new formation bone on the medial edge of the groove, we suppose a traumatic lesion.

Figure 1. Pathologic bones from the burial.

Table 5. Bones with pathological condition with an indication of the type of pathology and location. (R=right side; L=left side; I=adult indeterminate; M=adult male; F=adult female).

Bone	Com(plete)/ fr(agmentary)	R/L	Sex	Pathology
Cervical Vertebra	com		I	Osteophytes vertebral body
Cervical Vertebra	com		I	Diffuse osteophytes
Cervical Vertebra	com		I	Osteophytosis right vertebral body and Right inferior rib facet
Cervical Vertebra	com		I	Diffuse osteophytes
Cervical Vertebra	com		I	Osteophytosis superior left facet and inferior body
Thoracic Vertebra	com		I	Osteophytosis spinous process and anterior left facet
Thoracic Vertebra	com		I	Osteophytosis inferior rib facet and transverse process
Thoracic Vertebra	com		I	Osteophytosis transverse process
Thoracic Vertebra	com		I	Osteophytosis spinous process and vertebral body
Thoracic Vertebra	com		I	Osteophytosis rib facets
Thoracic Vertebra	com		I	Osteophytosis of vertebral foramen
Thoracic Vertebra	com		I	Osteophytosis spinous process
Thoracic Vertebra	com		I	Osteophytosis spinous process and left rib facet
Thoracic Vertebra	com		I	Osteophytosis inferior body
Thoracic Vertebra	com		I	Osteophytes vertebral foramen and hernia in inferior body
Lumbar Vertebra	com		I	Hernia in the inferior body facet
Lumbar Vertebra	com		I	Hernia in the inferior body
Lumbar Vertebra	com		I	Osteophytosis in inferior body and left rib facet, Hernia in superior body
Rib body	fr	L	I	Osteophytosis. tubercle
Rib body/head	fr	L	I	Osteophytosis superior body
Rib body/sternal	fr	L	I	Osteophytosis sternal end
Rib body/head	fr	L	I	Osteophytosis tubercle
Rib body/head	fr	L	I	Osteophytosis tubercle
Rib body	fr	L	I	Osteophytosis tubercle
Rib body/head	fr	R	I	Osteophytosis tubercle
Sternum	fr		I	Ossification of right costal cartilage manubrium
Clavicula	com	L	I	Osteophytosis sternal facets
Clavicula	fr	R	I	Osteophytosis and macroporosity sternal end
Clavicula	fr	L	I	Osteolisis acromial end
Humerus	com	R	M	Abnormal shape in medial epicondyle with osteophytosis; groove probably by a blade in lateral epicondyle;
Humerus	fr	L	M	Abnormal development in medial epicondyle
Ulna	fr	R	M	Pronounced osteophytosis in styloid process
Ulna	fr	L	I	Osteophytosis olecranon
Pelvis	fr	L	F	Neoplasm bone in anterior superior iliac spine and acetabular rim
Sacrum	fr		I	Lumbarization S1
Femur	com	R	M	Osteophytosis in superior articular surface; new formation bone in greater trochanter and transverse acetabular ligament; shape modification and osteophytosis on the top of linea aspera (pertrochanteric fracture?)
Femur	com	L	M	Shape modification and osteophytosis on the top of linea aspera

To study the depth, width, direction and the possible presence of signs, a mould of the groove was made (Figure 3). The analysis of the shape reveals a thinner groove in the deepest part, with a linear pattern and a surface characterized by the presence of parallel lines with an oblique angle, currently, a blade cannot be completely excluded.

Very interesting also, a pathological situation of the right femur (Figure 4). Located in the proximal diaphysis, in the sub-trochanteric position, evident mainly in the anterior (Figure 4b) and cranial (Figure 4c) face of the great trochanter. The shape and location of the lesion can be identified with the consequence of a pertrochanteric fracture.

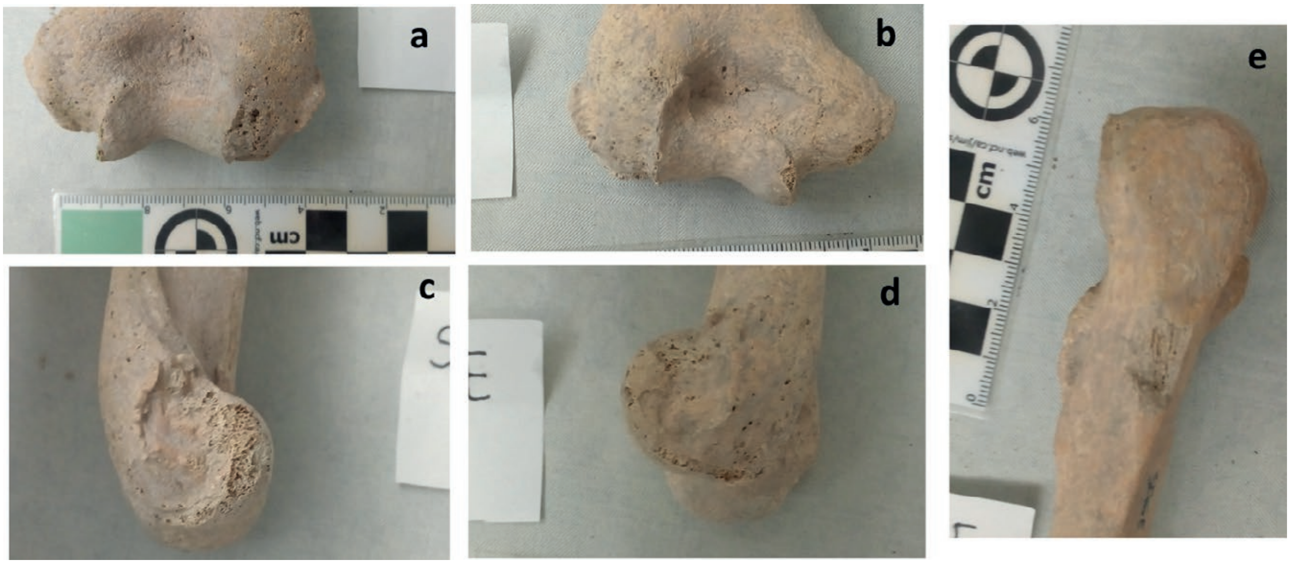

Figure 2. Pathological condition in forearm bones. (a= right humerus- anterior view of distal epiphysis; b= left humerus- anterior view of distal epiphysis; c= right humerus- medial view of distal epiphysis; d= left humerus- medial view of distal epiphysis; e= left ulna-dorsal view of proximal epiphysis).

Figure 3. Mould of the groove in the medial epicondyle of the right humerus.

Some pathologies found in contiguous bones suggest that these modifications may be related to each other. In addition, the general appearance is similar, and they can be attributed to an adult male (as mentioned before) and it is not completely excluded that they could be conferred to the same person.

For this reason, we have decided to consider markers of occupational stress (MOS) in these bones, as well.

Markers of Occupational Stress (MOS)

Analyzing MOS we have noticed the correspondence between lesions and more marked markers (Table 6).

We can see, indeed, in the upper limbs that a robusticity of 3 degrees is present in the right clavicle (Costoclavicular ligament) and distal right humerus (Brachioradialis muscle); high degree also at the insertion of the Deltoideus muscle in both humeri. All of these insertions are in the same locations as the lesion mentioned above.

In the lower limbs, we can see a higher degree of MOS in the right femur, corresponding to the Gluteus maximus muscle, where the possible fracture is present. The left side still has a high value, but not as high as the right side.

CONCLUSION

The multiple burials that we analyzed are an interesting case study, because of their composition. Of a total of four individuals, only one may be considered nearly complete.

Very interesting the pathologies present in 37% of the bones. These pathologies are, in most cases, ascribed to male individuals and it is possible that can be attributed to the same person. Considering this possibility, we can analyze the number of pathologies to understand possible relationships between them. A right humerus presents a possible blade injury at the medial epicondyle and this lesion can be related to the strong osteophytosis and macroporosity in the sternal epiphysis of the right clavicula and the pronounced osteophytosis in the styloid process of the right ulna. Moreover, MOS in

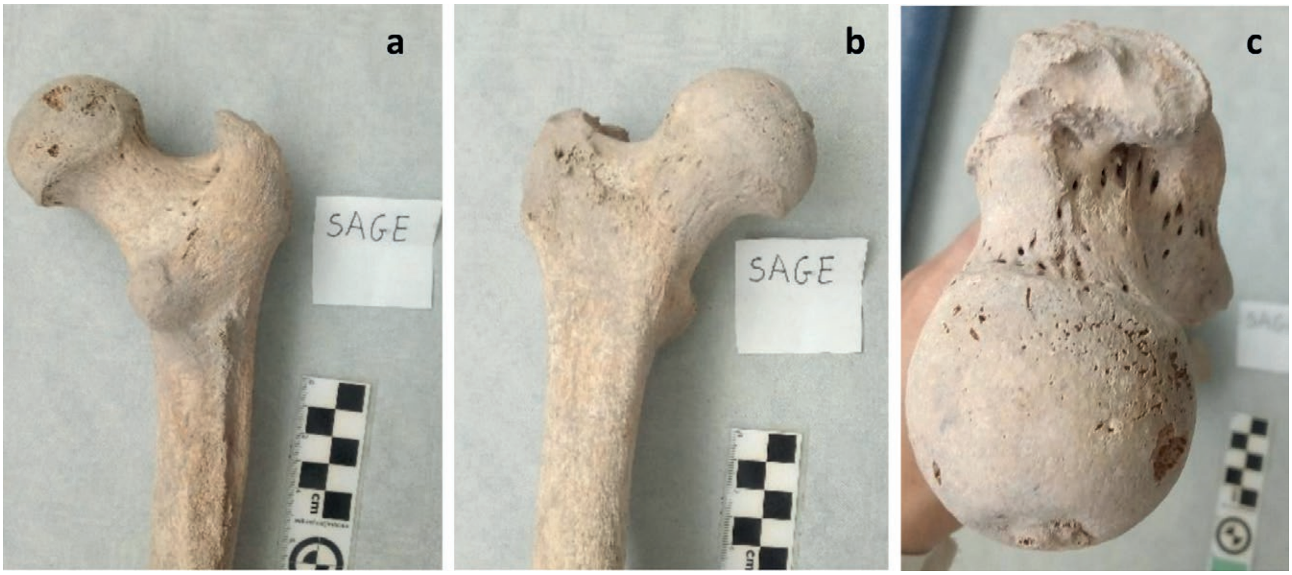

Figure 4. Lesion observed in the proximal epiphysis of the right femur. (a= posterior view; b= anterior view; c=cranial view).

the same bones is very high. Perhaps the movement of the right humerus may have been modified and difficult, with consequences on the whole joint.

Another interesting condition is on the femur. Here is present a lesion that interests the proximal epiphysis, maybe a perthocantheric fracture, resulting in a wrong walk which may have created the osteophytosis and the shape modification at the top of linea aspera of the left femur.

One more aspect of interest is the composition of the individuals in the burial. There are two adult males, one is a middle/old adult, and another one is a young adult. Furthermore is present a young adult female and one subadult (a child). Considering all these aspects, a family burial can't be completely excluded, but an additional genetic study should be done to better understand this aspect.

ACKNOWLEDGEMENT

Supported by the "Fondo di Ateneo per la Ricerca 2019-2020".

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Table 6. Robusticity in Markers of occupational stress observed in pathologic male bones standardized to the Coimbra method protocol. (L=left side; R=right side).

Bone	Side	Male	
		L	R
Scapula	Triceps brachii m.		
	Costoclavicular lig.	1,5	3
	Conoid lig.	1,7	
Clavicle	Trapezoid lig	1,5	
	Pectoralis major m.	1,7	0
	Deltoideus m.	1,7	
	Pectoralis major m.		2
Humerus	latissimus dorsii/teres major mm		1,7
	Deltoideus m.	2	2
	Brachioradialis m.	1,7	3
	Biceps brachii m.		
Radius	Pronator teres m.		
	membr.interossea		
	Triceps brachii m.	1,5	
Ulna	Brachioradialis m.	1,7	
	Supinator m.	1,3	
	Gluteus maximus m.	2	3
Femur	Ileopsoas m.		2
	Vastus medialis m.	1,7	1,5
Patella	Quadriceps tendon		
Tibia	Quadriceps tendon		
	Soleus m.		
Talus	Achilles tendon		
		1,66	2,02

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