

Gaming and divination pieces, markers of ownership,  
or all three? Zooarchaeology and the interpretation  
of knuckle bones found in tombs  
of the Iberian necropolis of El Poblado  
(Coimbra del Barranco Ancho, Murcia, Spain)

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Objets en os travaillé ou en ivoire trouvés dans la tombe 43 de la nécropole ibérique d'El Poblado. Crédit photo: J. Gómez Carrasco / *Modified bone or ivory objects found in tomb 43 of the Iberian necropolis of El Poblado. Photo credit: Gómez Carrasco J.*

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# Gaming and divination pieces, markers of ownership, or all three? Zooarchaeology and the interpretation of knuckle bones found in tombs of the Iberian necropolis of El Poblado (Coimbra del Barranco Ancho, Murcia, Spain)

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## ABSTRACT

Natural and worked astragali or knuckle bones dating from the Neolithic are common finds in Eurasia and are usually thought to be related with gaming, divination or protection. Knuckle bones/astragali (N = 549) and imitations (N = 11) were found in 27 of the 158 tombs that have been studied in the El Poblado necropolis, Murcia, Southeast Spain (fourth-second century BC), forming one of the most important knuckle bone collections in an Iberian cultural site. The greatest concentrations were found in tombs of important and high-class individuals. Most of the knuckle bones/astragali are from sheep (*Ovis aries* Linnaeus, 1758) and had been burnt with the corpse of the deceased. The fact that knuckle bones occur as part of the grave goods of both sexes suggests the egalitarian use of these items. While certain modifications point to their probable use, unworked astragali could have symbolised ownership of flocks or been used for exchange. The significance of this item and the data collected are discussed within the social and cultural context of pre-Roman societies in the southeast of the Iberian Peninsula.

## KEY WORDS

Astragalus,  
funerary offering,  
Iberian culture.

## RÉSUMÉ

*Pièces de jeu, objets de divination, symboles de propriété ou les trois ? Zooarchéologie et interprétation des osselets trouvés dans les tombes de la nécropole ibérique d'El Poblado (Coimbra del Barranco Ancho, Murcie, Espagne).* Les astragales ou os d'articulation naturels et travaillés datant du Néolithique sont des découvertes courantes en Eurasie et sont généralement considérés comme liés au jeu, à la divination et à la protection. Dans l'échantillon de la nécropole ibérique d'El Poblado, Murcie (sud-est de la Péninsule Ibérique), 549 osselets et 11 imitations ont été identifiés dans 27 des 158 tombes étudiées et datées entre le quatrième et le deuxième siècle avant J.-C. Cet ensemble est l'un des plus importants référencés dans la culture ibérique. Les plus grandes concentrations d'osselets ont été trouvées dans les tombes d'individus importants et de haut rang. La plupart des osselets identifiés proviennent de moutons (*Ovis aries* Linnaeus, 1758) et, à en juger par les colorations, ont été brûlés dans le bûcher funéraire. Les tombes des femmes et des hommes contiennent autant d'osselets, ce qui suggère l'utilisation égalitaire de ces objets. Si certaines modifications indiquent leurs utilisations probables, les astragales non travaillés pourraient symboliser la propriété des troupeaux et avoir été utilisés comme valeur d'échange et de transaction dans l'activité commerciale. L'importance et le symbolisme de ces éléments et de l'ensemble de données archéologiques sont évalués dans le contexte social et culturel des sociétés pré-romanes de la Péninsule ibérique.

**KEY WORDS**  
Astragale,  
offrande funéraire,  
culture ibérique.

## INTRODUCTION

Knuckle bone refers to the astragalus bone that articulates the tibia with the other foot bones in mammals. In Eurasia since the Neolithic, knuckle bones have been prepared and used as objects with multiple roles. Hoards of knuckle bones are common during the Iron Age, especially in the Aegean world (Gilmour 1997). The proliferation of knuckle bones for gaming or as symbolic objects in the east and south of the Iberian Peninsula has traditionally been interpreted in the context of Greek commerce in the Mediterranean, even though the chronology and location of the first findings make it more feasible to relate this practice with Phoenician influences (Bernáldez Sánchez *et al.* 2013; Arruda 2021).

The sacrifice of animals as mediating agents in rituals is determined by several factors, including the economic role they play in the community. Consequently, both animals and the deposited anatomical parts are clues that offer important information in this respect (Trantalidou & Kavoura 2008).

Hoards of knuckle bones are common in Iberian period necropoles and sanctuaries (Rísquez & García Luque 2007; Bernáldez Sánchez *et al.* 2013), including the El Poblado necropolis, which is part of Coimbra del Barranco Ancho archaeological site in Jumilla, Murcia (Spain). This necropolis is considered to be an outstanding example of knuckle bone/astragali assemblages in Europe. A thorough study of the *oppidum* and the El Poblado necropolis, which has been on-going since 1977, has permitted hypotheses to be made about the use of animals for food and their significance when included in funerary deposits.

Although there is a preliminary work about El Poblado knuckle bones (Gallardo 2014), it is incomplete, not updated and some taxonomic identifications are incorrect. However, a comparative analysis of the tombs containing knuckle bones/astragali and imitations has allowed us to develop a hypothesis about their use and significance in relation to the

status, age and sex of the deceased. Due to the good state of preservation of the structures, the studied grave goods can be considered as being representative of the initial deposits. The number of objects deposited as grave goods, including personal adornments or artifacts made from gold, silver or glass paste, weapons, horse harnesses, craft-related tools, such as awls and spindle-whorls, and pottery (including imported Attic vessels), is considered to mark the distribution of wealth in Iberian society – the larger the number of items found, the greater the wealth of the deceased (García Cano & Gualda Bernal 2019: 15). In El Poblado necropolis, knuckle bones/astragali were studied separately, and were not taken into account to establish the “wealth index” (WI) of individuals.

The percentages of different species represented in the hoards of knuckle bones, the faunal remains from the *oppidum* and the animal offerings from the necropolis were compared to help understand the significance of knuckle bones/astragali beyond their functional and cultural uses.

## POSSIBLE USE AND SIGNIFICANCE OF KNUCKLE BONES IN THE MEDITERRANEAN BASIN

Knuckle bones were used for gaming until very recent times in Western Europe (e.g., Budd & Newman 1941; Beguiristain 2018), while hoards of knuckle bones have often been found in funerary or sacred contexts dating from the Early Bronze Age in the Eastern Mediterranean and Levant areas (Gilmour 1997; Sidéra & Vornicu 2016) and also in the Central Mediterranean area. Those that present signs of abrasion or flattening may have been used as tools for smoothing ceramics or as gaming pieces. Abrasions that accentuate the cubic shape of the bone would facilitate the use of its four most important faces. They may also have been used as protective amulets, for divination purposes, as weights, or as objects with an exchange value (Trantalidou &



FIG. 1. — Location of the Coimbra del Barranco Ancho site.

Kavoura 2008). Divination through the casting of lots is based on the same principle as the game of dice. Astragali are used as dice assigning a value to each face. The meaning of the position of the bone was interpreted in relation to the formulation of questions (Holmgren 2004). The most frequently found knuckle bones come from species with an astragalus bone which has a natural cubic shape, such as sheep (*Ovis aries* Linnaeus, 1758), goat (*Capra hircus* Linnaeus, 1758), cow (*Bos taurus* Linnaeus, 1758), deer (*Cervus elaphus* Linnaeus, 1758) and, occasionally, pig (*Sus scrofa* Linnaeus, 1758).

The large hoards found in Greek and Italic sites deserve special mention. For example, over 22 000 knuckle bones were found in the Corycian cave near Delphi, so named after an ancient Greek oracle from the second half of the first millennium BC (Amandry 1984; Poplin 1984; De Grossi Mazzorin 2014: 83). Some of the most outstanding cases in Italy are the necropoli delle Grotte (Populonia) and Varranone (Poggio Picense), both dating from the fourth to the second century BC (De Grossi Mazzorin & Minniti 2013).

Knuckle bones from Iberian settlements in the Murcia Region have been interpreted as gaming pieces in the context of a Mediterranean acculturation process (García Cano 1997). Important accumulations of such pieces have been found in the El Poblado necropolis and the nearby site of El Cigarralejo, where 300 astragali were found in one tomb (tomb 200, believed to be of a female; Rísquez & García Luque 2007). Certain aspects of tomb 100 of the Cruz del Negro necropolis (Seville), where 210 caprine knuckle bones dating from the eighth century BC were found, suggest a possible Phoenician origin for the funerary rituals in use (Bernáldez Sánchez *et al.* 2013: 329, 338). This site may well exemplify an early example of the knuckle bone hoard phenomenon in the Iberian Peninsula.

In certain archaeological contexts, it has been proposed that knuckle bones were used as primitive money or counters relating to the value of sacrifices offered to the gods in temples (Holmgren 2004). In some Iberian sites, their use has been related to the commerce of textiles. For example, in the El Cigarralejo site, 300 astragali were found associated with imported items and tools, such as bobbins, bronze weights and a great number of spindle-whorls, and have consequently been interpreted as being related with the working and exchange of wool (Rísquez & García Luque 2007: 162).



FIG. 2. — View of the Coimbra del Barranco Ancho site. Photo credit: J. M. García Cano.

## THE COIMBRA DEL BARRANCO ANCHO SITE AND THE EL POBLADO NECROPOLIS

The Coimbra del Barranco Ancho site is situated 700-825 m above sea level, in a geographically strategic area that is connected to the interior of the Iberian Peninsula and the coast of southeastern Spain (Fig. 1).

The site comprises a residential area (3000 m perimeter), a sanctuary and three necropoles, of which the El Poblado necropolis, lying east of the main gate, is the most important (Fig. 2).

The *oppidum* was in use from the fifth century BC until the second century BC, reaching its peak during the fourth century BC. It was destroyed and abandoned after the Second Punic War. It was occupied by the Contestani people of Iberian Culture, who lived in the centre and northern areas of present-day Murcia province and the southern areas of Albacete and Alicante provinces. Iberian Culture flourished between the end of the sixth century and the end of the first century BC, when the full Romanization of the region takes place. It encompassed the different indigenous groups occupying the Mediterranean area of the Iberian Peninsula, who shared cultural characteristics. Land and the general population (farmers and craftsmen) were controlled by elites. Social and territorial complexity increased as a result of contact with Phoenician and Greek merchants, which led to a growing trade in metal, wine, wool, etc. The Iberian culture disappeared with the final Romanization of Hispania (Gracia 2009; Collado 2014).

In Coimbra del Barranco Ancho, the main economic activities were cereal crop growing and herding. The faunal remains (NISP) recovered from the *oppidum* show that the main livestock was sheep, followed by goats, which, together, accounted for 48.7% of the fauna studied. The age at death of the caprines reflects the wish to renovate herds, while the slaughter pattern points to their importance for obtaining meat, wool and milk. Meat was also obtained by raising cattle (6.8% of the faunal

TABLE 1. — Knuckle bones/astragali, and imitations, of Sheep. The sex of the human remains was studied through osteology and according to the grave goods. Most of the deceased were adults, but the remains of youths and infants were also found. Abbreviations: **F**, female; **ind.**, indeterminate; **M**, male; **NISP**, number of identified specimens.

Burial	Chronology BC	Human sex	Number of			Total sheep/goat ( <i>Ovis Aries</i> Linnaeus, 1758)/ ( <i>Capra hircus</i> Linnaeus, 1758) and indeterminate caprines	Pig ( <i>Sus scrofa</i> Linnaeus, 1758)	Red deer ( <i>Cervus</i> <i>elaphus</i> Linnaeus, 1758)	Roe deer ( <i>Capreolus</i> <i>capreolus</i> Linnaeus, 1758)
			Items	Astragali	Imitations				
86	400-300	M	7	3	—	3	—	—	—
127	400-300	M	9	11	—	11	—	—	—
75	375-350	M	23	174	2	162	—	—	12
113	375-350	M	29	43	—	42	—	—	1
96	375-340	Young F	18	—	3	—	—	—	—
26	350-325	F	4	1	—	1	—	—	—
70	350-325	Young F	94	93	3	77	7	—	9
116	350-325	M	21	102	—	99	—	3	—
46	350-315	F	31	6	—	6	—	—	—
124	350-275	F	6	3	—	3	—	—	—
36	300-250	F	17	30	—	28	—	—	2
66	325-250	M	11	1	—	1	—	—	—
7	300-200	F	17	11	—	10	—	1	—
56	275-225	M	6	11	—	11	—	—	—
55	225-175	Adult M	32	33	—	33	—	—	—
9	200-175	Infant ind.							
18	200-175	Young M	3	9	—	9	—	—	—
21/25	200-175	Infant ind.	5	3	—	3	—	—	—
43	200-175	F	5	1	—	—	—	—	1
53	200-175	Young M	11	—	3	—	—	—	—
84	indeterminate	F	2	3	—	3	—	—	—
112	indeterminate	M	3	1	—	1	—	—	—
		F	6	1	—	1	—	—	—
<b>NISP</b>		—	—	540	11	504	7	4	25
<b>%</b>		—	—	—	—	93.3	1.3	0.7	4.6

remains) and pigs (6.6%), and hunting cervids (8.3%). Bovines and equines (0.2%) were used for labour and transport, as the adult and senile age of death reveals (Albizuri 2019).

Imported goods (mainly decorated Attic pottery and black glazed pottery) are evidence of a constant exchange with Greek merchants from the fifth century BC onwards. About a hundred dishes, plates, cups and bowls, which had been used for long periods of time and finally deposited as grave goods in the tombs from all three necropolises, were found.

The El Poblado necropolis was used from 390/380 BC until the second century BC, when the settlement was destroyed and abandoned. It started being used following the population increase that coincided with the restructuring of the *oppidum*. Of the 160 tombs found, mainly for individual use, most belong to adults (c. 90%) and the rest to children older than three and young adults. The necropolis occupies an area of 400 m<sup>2</sup> and consists of five levels of burials. The funerary ritual involved cremation, and the colouring of the bones shows that corpses were burnt at 600-800°C, sometimes accompanied by offerings of animals and other grave goods. Afterwards, the remains were moved to the funerary structure, where they were introduced accompanied by grave goods and offerings of animal remains.

A study of the 158 tombs that have been excavated revealed a small percentage of rich male and female tombs from the fourth century BC, and considered to be the local

elite (García Cano & Gualda Bernal 2019). Tomb 70 is of particular note – a female grave marked by a stone sculpture representing horse riders, which has been classified as “princely”. The tombs that contain more than 17 grave good items also contain weapons, horse bits and harnesses and imported pottery. The same tombs also contained the largest number of astragali, especially from sheep. However, during the third and beginning of the second century BC, such manifestations of wealth fell significantly.

The small faunal assemblages found in 41.6% of the structures in the necropolis are interpreted as symbolic offerings. The most commonly used species for these offerings were caprines, especially sheep (29.1%), followed by rabbits (*Oryctolagus cuniculus* Linnaeus, 1758) (27.7%). Of interest is the selection of the left radius and ulna of sheep with no signs of burning (Albizuri *et al.* 2015). Other species represented in these offerings are birds (14.3%), pigs (8.8%), cattle (2.4%), equines (1.2%) and marine molluscs and land snails (16.5%) (Albizuri 2019).

## MATERIALS AND METHOD

The total number of astragali found in the necropolis was 549, belonging to 27 burials. Of these we have analysed 540 astragali and 11 knuckle bone imitations belonging to 22 tombs (Table 1).

TABLE 2. — Number of identified specimens (NISP) and minimum number of individuals (MNI) obtained from knuckle bones/astragali and imitations. Burials with chronological data.

Burial	4th century BC									4th-3rd century BC				3rd century BC			2nd century BC					Total									
	NISP	MNI								NISP	MNI			NISP	MNI			NISP	MNI	NISP	MNI										
Human sex	M	M	M	M	F	F	F	M	F	F	F	M	F	M	F	M	M	F	M	F											
Sheep ( <i>Ovis aries</i> Linnaeus, 1758)	2	6	80	17	–	1	45	28	2	2	183	105	14	–	14	8	3	5	13	21	14	6	–	–	–	1	7	6	225	133	
Goat ( <i>Capra hircus</i> Linnaeus, 1758)	–	2	17	3	–	–	4	17	2	–	45	36	2	–	2	2	5	1	7	13	8	–	3	–	–	–	–	3	2	63	48
Caprines	1	3	65	22	–	–	28	54	2	1	176	97	12	1	13	8	2	5	13	20	12	3	–	–	–	–	2	5	4	214	121
Roe deer ( <i>Capreolus capreolus</i> Linnaeus, 1758)	–	–	12	1	–	–	9	–	–	–	22	15	2	–	2	1	–	–	–	–	–	–	–	–	1	–	–	1	1	25	17
Red deer ( <i>Cervus elaphus</i> Linnaeus, 1758)	–	–	–	–	–	–	–	3	–	–	3	2	–	–	–	–	1	–	–	1	1	–	–	–	–	–	–	–	–	4	3
Pig ( <i>Sus scrofa</i> Linnaeus, 1758)	–	–	–	–	–	–	7	–	–	–	7	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	4
Imitations	–	–	2	–	3	–	3	–	–	–	8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	3	–	11	–
<b>TOTAL</b>	<b>3</b>	<b>11</b>	<b>176</b>	<b>43</b>	<b>3</b>	<b>1</b>	<b>96</b>	<b>102</b>	<b>6</b>	<b>3</b>	<b>444</b>	<b>259</b>	<b>30</b>	<b>1</b>	<b>31</b>	<b>19</b>	<b>11</b>	<b>11</b>	<b>33</b>	<b>55</b>	<b>35</b>	<b>9</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>19</b>	<b>29</b>	<b>549</b>	<b>326</b>	

Anatomic and taxonomic identification was based on the reference collection from Universitat de Barcelona Archaeology Lab and by identifying certain diagnostic elements (especially in the case of caprines) (Boessneck *et al.* 1964; Prummel & Frisch 1986). The biometrical techniques used to characterise and identify taxa followed the criteria advanced by Driesch (1976) and Davis (2016). The estimation of withers height was made in accordance with the factors proposed by Teichert for sheep astragali: 2.268 multiplied by the greatest length of this bone measured in millimetres; the result obtained is in centimetres (Chaix & Méniel 2001). The different taphonomic agents that have affected the astragali were identified macroscopically following bibliographical criteria (Fernández-Jalvo & Andrews 2016). This review summarizes the alterations that occur in bone during the burning process, particularly their colouration (Albizuri *et al.* 1993). Bones and fragments (NISP) and individuals (MNI) were quantified following the classical formulas (Grayson 1984).

## RESULTS

Astragali were found in tombs belonging both to males and females, regardless of the number of other grave good items (Table 1). However, the large assemblages appeared in tombs with a higher count of items (more than 17) dating from the fourth century BC. These were usually male tombs, while the percentage of female tombs was slightly lower. Moreover, the

existence of tombs belonging to sub-adults (younger than 15) containing large grave good assemblages may indicate the inheritance of class and status (for example, tomb 70). Small assemblages of astragali made up of only a few items were found in both male and female tombs containing a limited number of grave goods.

According to the NISP and MNI (Table 2), most astragali belonged to sheep.

From the third century BC, the number of knuckle bones/astragali fell significantly, coinciding with a decrease in manifestations of wealth (Tables 1, 2).

The most numerous species to which the knuckle bones/astragali belong are caprines, mainly sheep (except during the third century BC, when the number of sheep equalled the number of goats) (Fig. 3). Other species that have been documented are roe deer (*Capreolus capreolus* Linnaeus, 1758), red deer and pig, mainly in fourth century BC tombs.

Three representative examples of the flocks of sheep and goats that provided the astragali over a 50 year period (375-325 BC) were selected to calculate NISP per taxons and MNI according to the side, and are presented in Table 3. Tombs 75 and 116, both corresponding to males, contained a higher percentage of caprines than the grave exemplified by the female tomb, number 70. In all three of them, however, sheep were the most common species. Interestingly, these depositions are amongst the few that contain roe deer astragali and also, in the case of tomb 70, pig. Tomb 119 also contained red deer astragali.

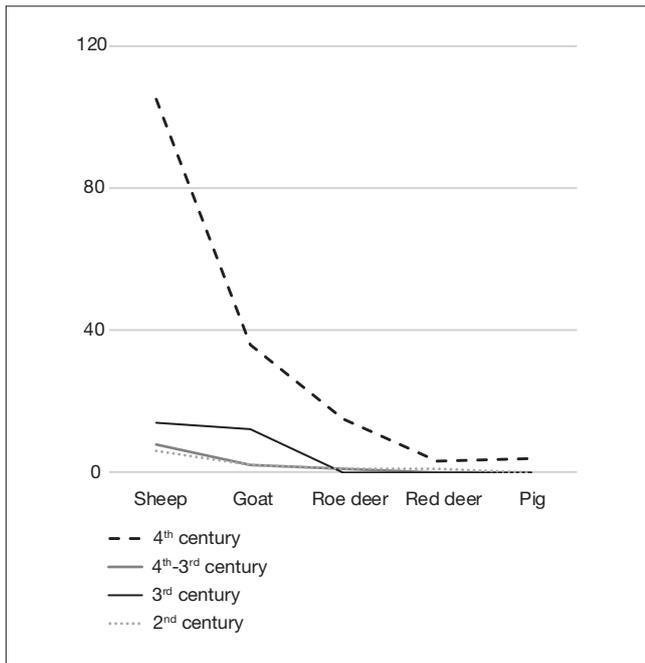


FIG. 3. — Minimum number of individuals (MNI) calculated from the astragali assemblage of Sheep (*Ovis Aries* Linnaeus, 1758), Goat (*Capra hircus* Linnaeus, 1758), Roe deer (*Capreolus capreolus* Linnaeus, 1758), Red deer (*Cervus elaphus* Linnaeus, 1758) and Pig (*Sus scrofa* Linnaeus, 1758).

TABLE 3. — Number of identified specimens (NISP) and minimum number of individuals (MNI) obtained from knuckle bones/astragali of Sheep (*Ovis Aries* Linnaeus, 1758), Goat (*Capra hircus* Linnaeus, 1758), indeterminate caprines, Roe deer (*Capreolus capreolus* Linnaeus, 1758), Red deer (*Cervus elaphus* Linnaeus, 1758) and Pig (*Sus scrofa* Linnaeus, 1758) in graves 75, 70 and 116. Abbreviations: F, female; l, left; M, male; r, right.

	75 (M)			70 (F)			116 (M)		
	NISP	%	MNI	NISP	%	MNI	NISP	%	MNI
Sheep	80	46.0	–	45	48.4	–	28	27.5	–
Right	–	–	40	–	–	21	–	–	17
Left	–	–	40	–	–	24	–	–	11
Goat	17	9.8	–	4	4.3	–	17	16.7	–
Right	–	–	4	–	–	–	–	–	4
Left	–	–	13	–	–	4	–	–	13
Caprines	65	37.4	–	28	30.1	–	54	52.9	–
Right	–	–	28	–	–	16	–	–	28
Left	–	–	37	–	–	12	–	–	26
Total caprines	162	93.1	90 (l)	77	82.8	37 (r)	99	97.1	50 (l)
Roe deer	12	6.9	–	9	9.7	–	–	–	–
Right	–	–	4	–	–	3	–	–	–
Left	–	–	8	–	–	6	–	–	–
Red deer	–	–	–	–	–	–	3	2.9	–
Right	–	–	–	–	–	–	–	–	1
Left	–	–	–	–	–	–	–	–	2
Pig	–	–	–	7	7.5	–	–	–	–
Right	–	–	–	–	–	3	–	–	–
Left	–	–	–	–	–	4	–	–	–
<b>Total</b>	<b>174</b>	<b>–</b>	<b>98</b>	<b>93</b>	<b>–</b>	<b>40</b>	<b>102</b>	<b>–</b>	<b>52</b>

TABLE 4. — Modified and burnt knuckle bones (imitations excluded).

Burial	Astragali	Perforated	Polished	%	Unburned	Burned	Brown/Gold	Brown	Black	Grey	White
86	3	–	–	–	–	3	–	–	–	3	–
127	11	–	1	9.1	–	10	–	–	–	3	7
75	174	3	59	33.9	19	155	7	6	40	62	40
113	43	–	3	7.0	–	43	–	–	1	26	16
26	1	–	–	–	–	1	–	1	–	–	–
70	93	3	9	9.7	2	91	–	–	1	57	33
116	102	1	20	19.6	–	102	23	8	9	37	25
46	6	–	2	33.3	–	6	–	–	–	2	4
124	3	–	–	–	–	3	–	–	–	1	2
36	30	1	3	10.0	–	30	2	–	3	10	15
66	1	–	–	–	–	1	1	–	–	–	–
7	11	–	6	54.5	–	11	3	1	–	–	7
56	11	–	5	45.5	–	11	1	1	7	1	1
55	33	1	9	27.3	–	33	5	8	6	12	2
9	9	1	1	54.5	–	9	–	–	–	2	7
18	3	–	–	–	–	3	–	–	3	–	–
21/25	1	–	–	–	–	1	–	–	1	–	–
53	3	–	2	66.7	–	3	–	1	–	1	1
84	1	–	–	–	1	–	–	–	–	–	–
112	1	–	–	–	–	1	–	–	1	–	–
<b>TOTAL</b>	<b>540</b>	<b>10</b>	<b>120</b>	<b>–</b>	<b>22</b>	<b>517</b>	<b>42</b>	<b>26</b>	<b>72</b>	<b>217</b>	<b>160</b>
<b>%</b>	<b>–</b>	<b>1.9</b>	<b>22.2</b>	<b>–</b>	<b>4.1</b>	<b>95.7</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>–</b>
<b>% burned</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>–</b>	<b>8.1</b>	<b>5.0</b>	<b>13.9</b>	<b>42.0</b>	<b>30.9</b>

Withers height was calculated from 188 sheep astragali taken from 18 graves. The results point to heights ranging from 46.7 to 65.5 cm, with the highest concentration lying between 50 and 57 cm. In tomb 75 (from which 63 astragali were used to calculate withers height), 25.4% measured 58 cm and over and probably belonged to male sheep, given that male sheep are larger than females. The 19% that measured less than 50 cm

presumably would have belonged to young specimens. This composition is the same as found in the rest of the tombs studied.

Some knuckle bones show human modifications. Twenty-four percent of the knuckle bones/astragali show abrasions and perforations (Table 4). The abraded ones (22.2%) (Table 4) are characterised by reduced edges of the medial and lateral faces, thus providing a more cubic shape to the bone. Twenty-nine items



FIG. 4. — Tomb 116, “Triangular pyramid” shaped knuckle bones (caprines). Scale bar: 1 cm. Photo credit: J. Gómez Carrasco.



FIG. 5. — Tomb 46, perforated knuckle bone. Scale bar: 1 cm. Photo credit: P. Thomas.

(5.4%) were extremely modified, giving the bone an almost triangular shape, including three of the four red deer astragali (Fig. 4).

Some knuckle bones (1.9%) (Table 4) are perforated in a dorsal-plantar direction (Fig. 5). Eleven imitations (Table 1) are bones that have been modified to imitate the shape and size of caprine astragali (Fig. 6). Modifications are less frequent in astragali dating from the fourth century BC tombs. In the larger assemblages, 7 to 34% of knuckle bones were abraded (Table 4).

The high proportion of burnt bones (95.7%) and the uniform white, grey and black colourations (86.8%) (Table 4; Fig. 7) can be linked to high temperatures and prolonged exposure to fire (Albizuri *et al.* 1993), which suggests they were burned with the deceased on the funerary pyre, where temperatures would have reached 600-800°C. The brown/golden colourings observed (Fig. 8) are probably related with a greater distance from the source of heat.

## DISCUSSION

Species from which the knuckle bones/astragali were obtained between the fourth and second century BC are very similar to those of the food remains from the *oppidum* and the funerary offerings. The remains show a predominance of caprines, and, within this group, sheep are more common than goats (for the funerary offerings see Table 2). These were, without doubt, the most important species in the general economy of the Iberians.

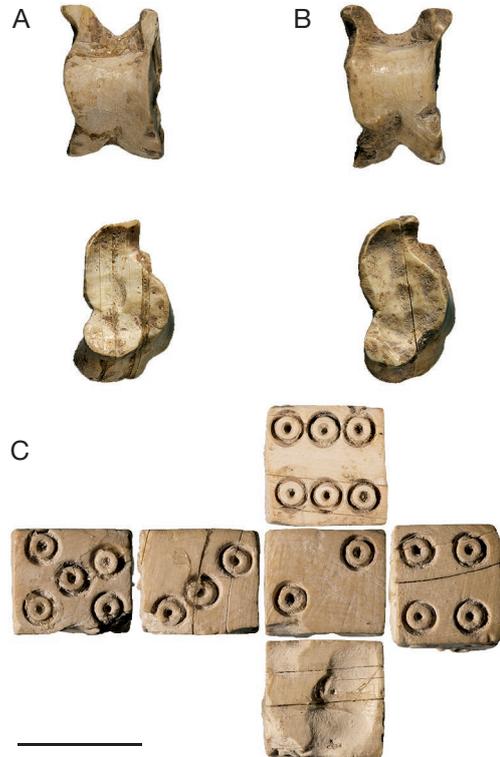


FIG. 6. — Some examples of modified bone or ivory objects from Tomb 43. **A, B**, two imitation astragali in “plantar” and “lateral” view; **C**, different faces of the ivory dice recovered (according to Blasco Martín 2016: 249). Scale bar: 1 cm. Photo credit: J. Gómez Carrasco.



FIG. 7. — Knuckle bones found in Tomb 70. Scale bar: 2 cm. Photo credit: J. Gómez Carrasco.



FIG. 8. — Knuckle bones found in Tomb 116. Scale bar: 2 cm. Photo credit: J. Gómez Carrasco.

The ages at death also show similar patterns. In the *oppidum*, the remains of adult animals of between 24 and 48 months indicate that herds were kept to obtain meat, milk and wool. The procurement of tender meat and the renovation of the herd can be inferred from the smaller proportion of sub-adult specimens (Albizuri 2019). The remains from the faunal assemblages of the necropolis show that most specimens were sacrificed after reaching three years of age, although some were between one and two years old (28%). A smaller proportion was less than one year old (8%) (Albizuri *et al.* 2015). The estimated withers height obtained from the knuckle bones/ astragali reflect the predominance of adult animals, with a lower percentage of sub-adults and fewer males. A similar phenomenon has been observed in Greek sacred sites from the second half of the first millennium BC, where adult caprines or animals that were important to the local economies were used to obtain knuckle bones. This suggests that animals of high economic value were used as offerings (Trantalidou & Kavoura 2008).

As mentioned above, the percentage of burnt bones (95.6%) (Table 4) and the high incidence of black and white colouring show that most knuckle bones were burnt at the same time as the corpse. However, other processes related to the burning of offerings in specific structures can not be ruled out. Whatever the case, the deposition of these items inside tombs shows that they were considered grave goods, offerings, or both.

Modifications, perforations and the abrasion of one or more faces are evidence of their preparation and use as objects (Table 4). Abrasions (22.2%) may relate to their possible use as flatteners or polishers, especially considering they

were found accompanying other grave goods that relate to manufacturing processes (awls, needles and spindle-whorls). Studies on the modern-day use of knuckle bones in the Tibetan Plateau show that the medial, lateral and sometimes even proximal faces are abraded so that they can be used in a faster paced game. To illustrate interactions across the breadth of Eurasia that may have a bearing on astragalus traditions, it is important to note that the numerical values given to the different faces of an astragalus bone by Greeks and Romans are similar to those found in Mongolia and the Tibetan Plateau (Bellezza 2019). Abrasions may also have been motivated by the need for a cubic object for playing games, while the 5.4% of knuckle bones that present a triangular (more accurately a “triangular pyramid” shape) might be related to alternative game modes. The rectangular shape of the bone may have been the characteristic that led to the selection of caprines, whereas roe deer bones would have been chosen for their small size but similar shape to sheep and goat astragali. This would explain why irregularly shaped astragali e.g., from equids or dogs (*Canis familiaris* Linnaeus, 1758) were not used, although the seven pig astragali from tomb 70 are an exception. Cattle astragali were not chosen, probably because of their size.

Perforations in a dorsal-plantar direction (1.9%) (Table 4) could be related to their use as amulets, being hung as pendants for example, or to be filled with other materials that would add weight to the knuckle bone. The perforation and filling of knuckle bones is also common for use in faster paced games, such as those played in modern-day communities in Tibet (Bellezza 2019).

In the El Poblado necropolis, smaller assemblages were associated with a high percentage of female tombs (Table 1), and, judging by the small number of items and modifications (Table 4), they could have been deposited as symbolic offerings. The modified items may have been used as polishers or gaming pieces. Sets of knuckle bones used for games and divination are usually from caprines, although only a small number was needed. In ancient Greece and Rome sets of four or five knuckle bones (Amandry 1984; Nikulina & Schmölcke 2008) were used together with dice for both gaming and divination purposes. The finding of both dice and knuckle bones together in various Iberian sites (Blasco Martín 2016) could be interpreted in this way. For example, three dice and three astragali imitations were found in tomb 43 of El Poblado necropolis (some of them shown in Fig. 6).

The greatest numbers of astragali are from the fourth century BC, when assemblages consisting of more than a hundred items were found in the richest and most important tombs (Tables 1, 2). Many of these tombs include grave goods such as Attic and black glazed pottery, glass paste items, and even a Horus amulet. One of these rich tombs (tomb 70) belongs to a young woman under the age of 15, a fact that might reflect the inheritance of social status. Imported Greek pottery in the necropolis also points to a commercial relationship which could have influenced the amassing of knuckle bone hoards and the way in which they were used. In tombs 70, 75 and 116, less than half are modified (Table 4), suggesting a different use for the bones. A small percentage of modified astragali can be related to their use as gaming pieces or for divination purposes. However, great numbers of unworked astragali might be due to their being used in exchange processes or as property symbols, and, hence, as an expression of wealth.

The male tombs 75 and 116 show a higher percentage of caprines than the female tomb 70 (Table 3). The percentage of sheep varies approximately between 30 to 50%, similar to the food remains from the *oppidum* and to all the offerings found in the necropolis. These faunal assemblages act as a mirror of the main composition of the herds and probably their ownership. They might also indicate craftsmanship and commerce of wool. The presence of 300 astragali in the female tomb 200 of the Cigarralejo necropolis, also in Murcia, as well as other grave goods related to the working of wool could point to the commerce of textile. However, the presence of unworked pig astragali in tomb 70 of El Poblado may also indicate the different species exploited or owned by the elites. It is interesting to note that knuckle bones in modern day Mongolia symbolise the herd as well as the wellbeing and fertility of the animals, while in ancient Greek sanctuaries they could have been used as standardized values for offerings (Holmgren 2004). It is also interesting to note that the use of astragali as tools for calculating wealth is also seen in modern day Tibetan communities, who amass knuckle bones as a way to determine a person's wealth and financial status during their lifetime (Bellezza 2019).

## CONCLUSIONS

Analysis of the astragali from the El Poblado necropolis indicates the differentiated use of these items, which could be extrapolated to other Mediterranean areas where, from the second half of the first millennium BC, a Greek influence can also be felt. The hoards of knuckle bones found in the El Poblado necropolis suggest their wide use as gaming pieces, that is, objects with a cultural significance. They appear in both female and male tombs, regardless of the age and social standing of the deceased. From the fourth century onwards, they should be understood in the context of a Mediterranean acculturation process induced by Greek commerce, as can be inferred from the presence of imported materials in the wealthiest tombs. Astragali are a symbol of social differentiation. The smaller assemblages made up of only a few knuckle bones are more common in poor female tombs. The tombs of the wealthier individuals, both female and male, contain a great number of unworked items, which reflects the composition of the main animals kept, principally sheep. They could have been viewed as a symbol of animal ownership or that the deceased had been involved in working and exchange of wool. The large numbers in which they are found mean that they cannot be interpreted solely as gaming sets, objects for divination or amulets, but suggest the variety of uses to which these items were put.

The fact that both female and male tombs in Coimbra del Barranco Ancho contain knuckle bones as part of their grave goods suggests the egalitarian use of these items, both as symbols and for gaming. While they tend to be more common in wealthy male tombs, they are also found in the tombs of important women, in which large numbers of unworked astragali are sometimes found. This is another indicator of the important role played by women among Iberian elites.

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