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New human fossil to the last Neanderthals in central Spain (Jarama VI, Valdesotos, Guadalajara, Spain)

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Introduction

The Iberian Peninsula is one of the European areas containing both late Neanderthals and recent Mousterian remains (Finlayson et al., 2006). Doubts have been raised about the dates obtained in the 1970s and the integrity of several of these sites (Zilhão et al., 2011). Jarama VI (Valdesotos, Guadalajara, Spain), excavated in the 1990s, has a well-stratified deposit with radiocarbon dating (Jordá Pardo, 2001). Level 2 (unit J.VI.2) yielded an abundance of stone tools that were clearly designated as Mousterian, a small hearth with charcoal, burnt bones and faunal remains bearing cutmarks, denoting the presence of human consumption activity in a warm, wet phase of OIS3 (Jordá Pardo, 2007). A review of the Level 2 skeletal remains has permitted the identification of a human fossil that can provide a new source of discussion about the possible survival of Neanderthals beyond $\sim 33,000$ ¹⁴C yr BP (carbon-14 years before present). This is the first fossil that has been published from Jarama VI site.

Stratigraphy and chronology

According to Jordá Pardo (2007), the oldest sedimentary unit (J.VI.3) is a deposit formed by autochthonous limestone pebbles with shale gravels and rounded quartzite pebbles. This unit contains a rich Mousterian assemblage and bones of micro- and macromammals. The next unit (J.VI.2), composed of sands and lutites, is 10–160 cm deep, eroding on the level below. Its origin is clearly fluvial and is structured into three sub-units. The lowest sub-unit (J.VI.2.3) consists of overflowing facies with a predominance of sands that alternate with lutites. The middle sub-unit (J.VI.2.2) is a flood plain deposit with silts and clays. This facies contains scattered archaeological remains (bones and lithics), occasionally concentrated around a small hearth, evidenced by a concentration of charcoal and rubefaction of the silt sediment beneath it. Above this sub-unit and in the inner part of the rock shelter, the upper sub-unit (J.VI.2.1) consists of lutitic sands with clastic insertions and archaeological materials. The human remains presented in this paper are from the top of the middle sub-unit (J.VI.2.2). Above this unit is unit J.VI.1, which contains a large accumulation of archaeological remains. Finally, the stratigraphic record ends with a breccia and speleothem (J.VI.K).

Three conventional radiocarbon dates for the Jarama VI archaeological record were obtained at Beta Analytic Inc. Laboratory, Miami (Florida, USA) in 1992 and 1993 from three charcoal samples (Jordá Pardo, 2001). The oldest dates (Beta-56639 $32,600 \pm 1860$ BP and Beta-56638 $29,500 \pm 2700$ BP) are clearly associated with the dated Mousterian remains (Jordá Pardo, 2001). The 2σ calibration of both dates corresponds well with the presence of the last Neanderthals in central Iberia, dated between 52 and 34 kyr cal BP (thousands of years ago calibrated before present) (Díez et al., 2008).

Materials and methods

The Jarama VI F-4 II specimen is a proximal fragment of a left first metatarsal from an adult individual (Fig. 1). To study the

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Figure 1. Dorsal, medial, plantar, lateral and proximal view of the Jarama VI first metatarsal (scale in cm).

metatarsal, we analysed original fossils from La Ferrassie 1, La Ferrassie 2, Cro-Magnon, Abri Pataud (Musée de l'Homme, Paris), Moros de Gabasa (Museo Arqueológico Provincial de Huesca) and Tabun C1 (British Museum of Natural History, London). Measurements for Spy 25B, 25C and 25D metatarsals were obtained with ArteCore software on the digital surface models installed on the NESPOS platform (www.nespos.org). We have used some raw data published for La Ferrassie 1 and 2 (Heim, 1982), Shanidar 1 and 8 (Trinkaus, 1983a), Tabun C1, Skhul 3, Skhul 4 and Skhul 5 (McCown and Keith, 1939), Qafzeh 3, Qafzeh 8 and Qafzeh 9 (Vandermeersch, 1981), Dolní Věstonice (Sládek et al., 2000), and Moros de Gabasa (Lorenzo Lizalde and Montes, 2001). We included some original data from the extensive fossil collection from the Sima de los Huesos (SH) Middle Pleistocene site at Sierra de Atapuerca (Burgos) (Bischoff et al., 2007). Finally, a modern human sample from the Hamann–Todd collection housed in the Cleveland Museum of Natural History (Cleveland, Ohio) was used in the comparative analysis. The Hamann–Todd sample is composed of 47 individuals consisting of 22 Euroamericans and 15 Afroamericans.

Results

Description and preservation

The bone is broken through the shaft 47.8 mm from the most proximal point of the specimen. The base is well preserved with partially eroded regions on the medial and lateral sides. The maximum height of the base is 26.5 mm and the maximum breadth is approximately 19.9 mm (Table 1). The proximal articular surface is single, concave and has a kidney shape with a height of 23.5 mm

and a breadth of 12.5 mm. This proximal facet is oriented perpendicularly to the longitudinal axis of the metatarsal shaft, which indicates a fully adducted first ray of the foot. Within the proximal articular facet, we observe a slight mediolateral ridge running from the constricted area of the kidney shaped facet. Latimer and Lovejoy (1990) remark that the constriction of the tarsometatarsal joint is a key hominid feature reducing the mobility of the hallux.

The Jarama VI metatarsal has a subtriangular diaphyseal cross-section that is flat laterally and more rounded medially. The metatarsal diaphysis is flat dorsally but concave plantarly. Approximately at midshaft, the diaphysis measures 14.1 mm mediolaterally and 13.2 mm dorsopalmarly.

Although this region is partially eroded, in the Jarama VI metatarsal we distinguish a facet on the lateral border of the base for the articulation with the second metatarsal. Different authors have studied the frequency of the intermetatarsal facet of the first metatarsal (Wanivenhaus and Pretterklieber, 1989; Le Minor and Winter, 2003). Le Minor and Winter (2003) conclude that the human first intermetatarsal facet is a derived trait unique within primates (an autapomorphy), which is present in the 30.8% of his sample. Following Trinkaus (1983a), the facet is absent from between 67.5% and 91.0% of individuals in five recent human samples and 61.5% of a late archaic human sample. Some Neanderthals' first metatarsals exhibit such an accessory articular facet, including Spy 25B, La Ferrassie 1, and La Ferrassie 2. Facet MT1/2 is absent from both Dolní Věstonice 14 and Dolní Věstonice 15 (Sládek et al., 2000). Although the Neanderthal sample is not statistically significant and this feature has not been described systematically, Neanderthals seem to exhibit a high percentage of presence of this accessory facet.

Table 1
Dimensions of the Jarama VI first metatarsal and comparative samples (in mm).

		Articular length	Proximal breadth	Proximal height	Proximal articular breadth	Proximal articular height	Midshaft breadth	Midshaft height	Proximal index	Midshaft index
Jarama VI		(47.8) ^a	19.9	26.5	12.5	23.5	14.1	13.2	75.1	106.8
Fossil <i>Homo sapiens</i>	x	60.4	19.9	28.6	12.6	26.1	13.7	14.1	68.3	97.4
	SD	2.8	3.0	1.4	1.3	1.1	2.1	1.0	8.3	11.7
	n=	6	10	12	3	5	15	15	9	15
Neanderthals	X	56.6	19.9	28.0	13.8	26.9	13.5	11.8	72.4	116.4
	SD	4.2	2.9	4.3	1.5	3.2	1.4	1.6	6.6	17.1
	n=	8	10	8	8	8	10	10	8	10
Sima de los Huesos (Sierra de Atapuerca)	x	61.0	23.9	31.4	17.0	29.0	16.3	13.5	72.0	119.4
	SD	1.6	3.2	0.9	0.5	1.8	1.1	0.9	6.7	5.1
	n=	5	5	5	4	6	5	5	4	5
Hamann–Todd collection (n = 47)	x	63.0	20.2	29.2	17.1	26.5	13.1	13.9	69.3	94.1
	SD	4.5	2.2	2.3	3.8	4.4	1.8	1.5	4.8	8.9

Proximal index = (proximal breadth/proximal height) × 100; Midshaft index = (midshaft breadth/midshaft height) × 100.

Fossil *Homo sapiens* sample is composed of Cro-Magnon, Abri Pataud, Skhul 3, Skhul 4, Skhul 5, Dolní Věstonice 14, Dolní Věstonice 15, Dolní Věstonice 16, Qafzeh 3, Qafzeh 8 and Qafzeh 9.

Sima de los Huesos (SH) sample is composed of AT-987, AT-1711, AT-2496, AT-2808, AT-4441 and AT-4811.

Neanderthal sample is composed of La Ferrassie 1, La Ferrassie 2, Moros de Gabasa, Spy 25B, Spy 25C, Spy 25D, Shanidar 1, Shanidar 8 and Tabun 1.

^a Maximum length of the fragment.

At the inferior angle, we observed a rough oval prominence for the insertion of the tendon of the peroneus longus. The primary action of this muscle is the plantar flexion of the first ray of the foot and plantar flexion and eversion of the foot at the ankle during the stance phase of gait. The size of the peroneus longus insertion in the first metatarsal is highly variable in modern humans, and occasionally an accessory bone is present.

Carnivore damage

The metatarsal fragment exhibits a suite of bone surface modifications, probably caused by carnivore action. The distal metaphyses presents a crenulated fracture from chewing, associated with a one oblique score (width 0.9 mm) on the anterior side, and a pit (1.5 × 0.9 mm) on the posterior side. The diaphyseal midshaft is traversed by various pits (1.2 × 0.6, 1.1 × 1.0, and 1.1 × 0.9 mm) and a parallel series of small grooves (width 0.5, 0.3, 0.3, and 0.4 mm) perpendicular to the bone axis (Fig. 2). The pit morphology (bowl-shaped interiors), scores (U-shaped cross-sections), tooth scoring breadths and tooth pit dimensions match the values of small canids (Blumenshine, 1995; Delaney-Rivera et al., 2009). Amongst the faunal remains from Jarama VI, only 10.0% of faunal specimens exhibit carnivore tooth marks, manifested by fractures, furrowing and punctures. In almost all cases, the surface carnivore damage dimensions match those obtained for modern canids such as foxes or jackals (Dominguez-Rodrigo and Piqueras, 2003), making a fox probably the best candidate for alterations identified on the human metatarsal.

Archaeological record

We recovered 341 lithic artefacts. This assemblage consists of 24 hammerstones, 21 cores, 119 flakes, 23 retouched flakes and ten fragments. There are also 144 pebbles with no percussion marks or other evidence of having been part of different chaînes opératoire, although they were clearly brought to the site by humans. The most abundant raw material is quartz, followed by quartzite and rock crystal, all of local origin. Flint, which accounts for 6.0% of the assemblage, is of allochthonous origin.

Discoidal exploitation systems generally prevail in this assemblage, followed by multipolar, orthogonal, unipolar longitudinal and Quina reduction (Bourguignon, 1997). The Levallois method appears in quartzite and flint flakes, and in retouched flakes of flint, but no Levallois cores were found.

The cores do not bear evidence of preparation from nodules prior to extraction, and were not exploited to the point of exhaustion, with the exception of the single flint core, which is multipolar and exhausted. The size of the flakes and the retouched flakes are small and microlithic. In quartz, the most frequently used retouch is simple, forming notches and denticulates. Flint flakes were retouched to make sidescrapers and Mousterian points (Fig. 3), along with the only burin on this level. Knapping debitage suggests a possible resharpening of the tools. In the case of flint, they seem to have been inserted in the cavity as flakes or retouched

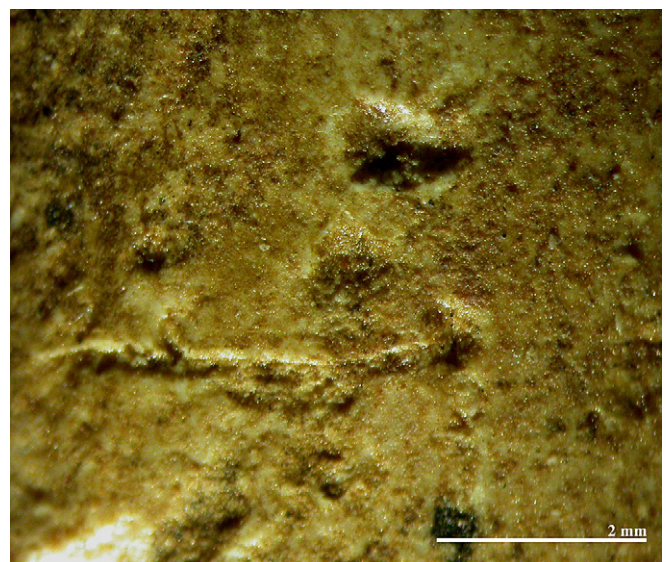


Figure 2. Pits and groove on the anterior side of the metatarsal from Jarama.

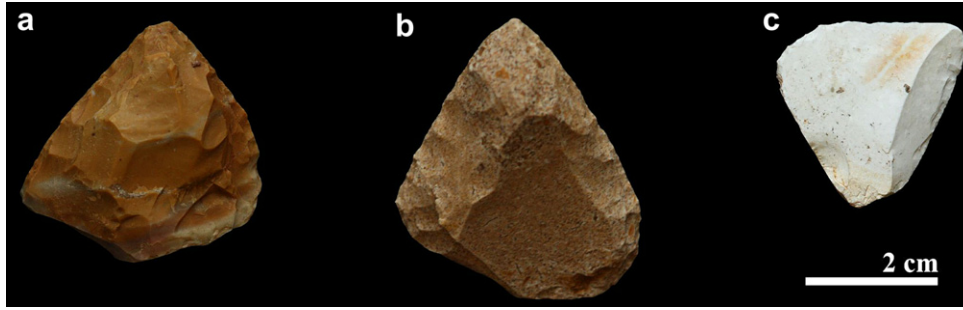


Figure 3. Retouched flakes of flint: a) and b) Moustertian points, c) sidescraper.

flakes, which were subsequently resharpened. Several items have a double patina, suggesting delayed exploitation.

The faunal remains are represented by micromammals including *Castor fiber*, *Pliomys cf. lenki*, *Microtus arvalis*, *Microtus agrestis* (the most abundant taxon), *Apodemus sylvaticus*, *Apodemus flavicollis* and *Oryctolagus cuniculus*. Macromammals include *Sus scrofa*, *Cervus elaphus*, *Rupicapra pyrenaica* and *Capra pyrenaica*. Additional remains include birds such as *Alectoris rufa*, *Pica pica* and *Pyrhcorax graculus*, amphibians such as *Pelobates cultripes*, and fish such as *Pisces* indet.

Amongst the ungulates, deer and goat are predominant and adults and juveniles of both species are presented and represented by all parts except metapodials and phalanges. Numerous cutmarks and

percussion marks on all herbivores were identified. We observed joint disarticulation, eviscerating, defleshing and filleting processes as well as the extraction of tongues and limb bone marrow.

Many of the long bone diaphyses as well as the Neanderthal metatarsals indicate minimal carnivore activity. The size of the tooth marks observed on the bone surface and the type of fracturing (Blumenschine, 1995; Dominguez-Rodrigo and Piqueras, 2003) suggest that these carnivores may have been canids (fox or immature wolf).

The micromammal assemblage suggests an open environment with abundant water, some wooded areas and temperate temperatures (Sesé, 1994). The macromammal assemblage corroborates this hypothesis, although it is more generalized.

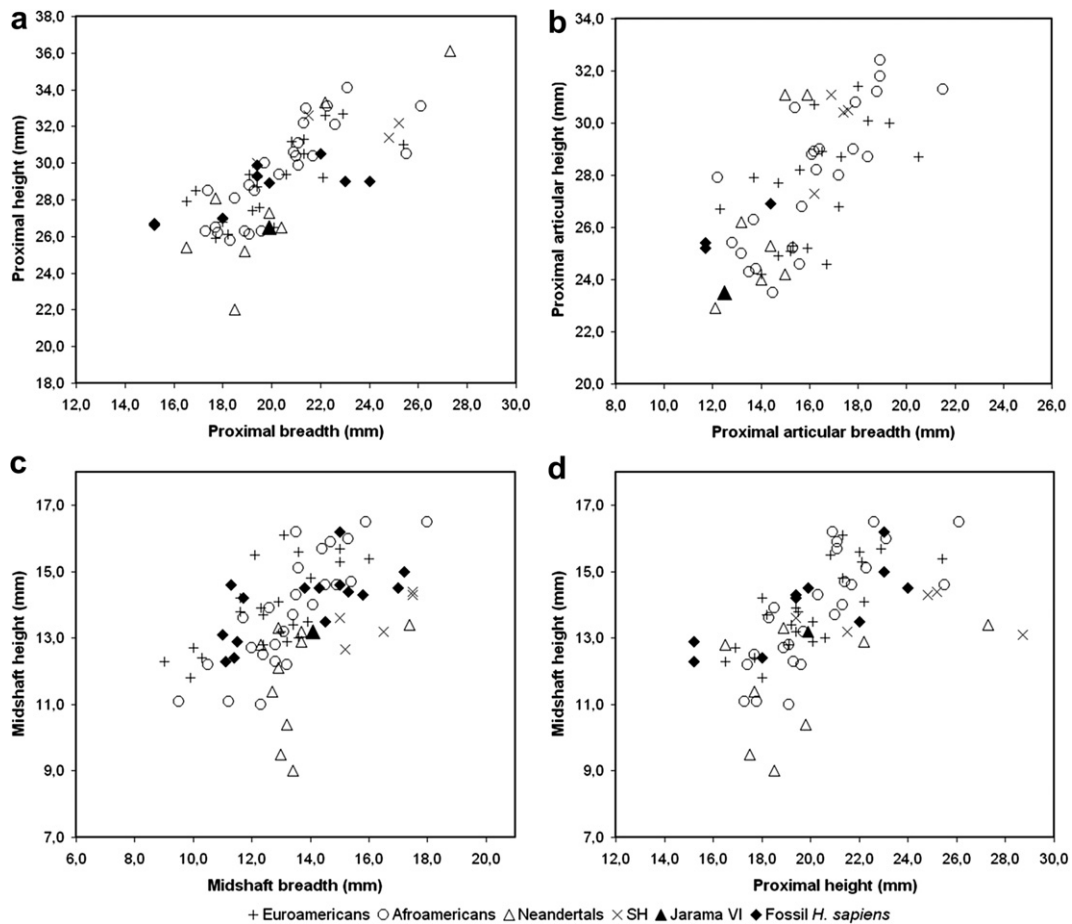


Figure 4. Metrical comparisons of the first metatarsal. a) Proximal height vs. proximal breadth, b) Proximal articular breadth vs. proximal articular height, c) Midshaft breadth vs. midshaft height, d) Proximal height vs. midshaft height.

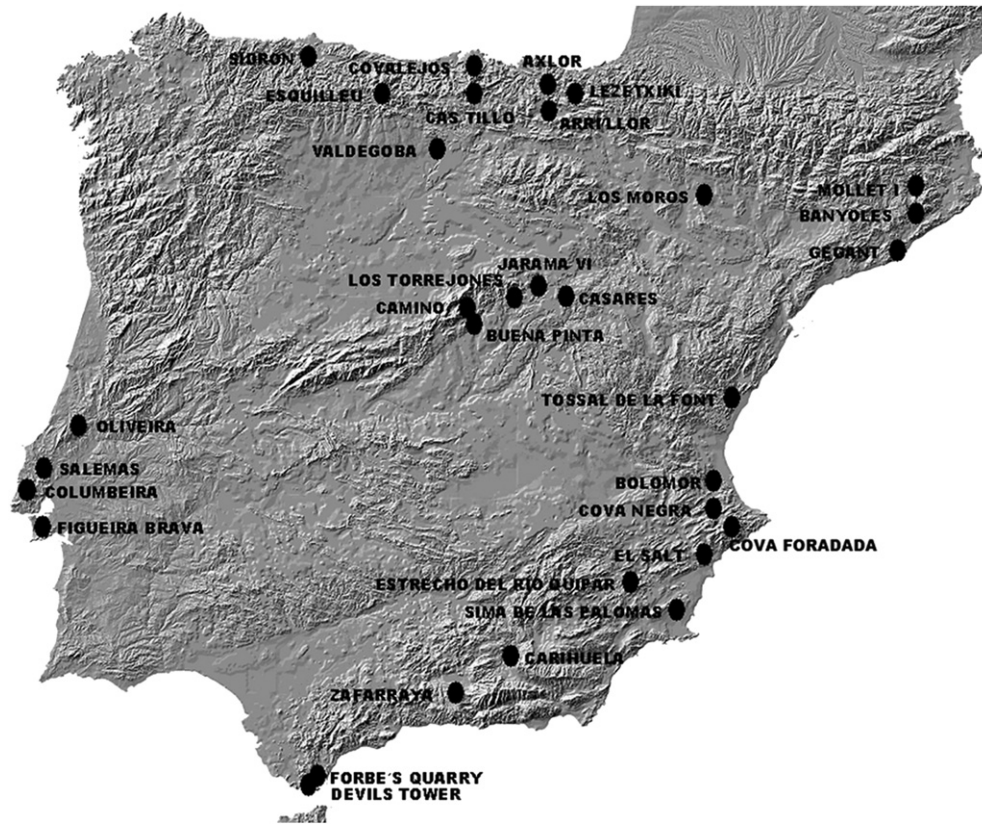


Figure 5. Distribution of the Neanderthal remains in Iberia.

Conclusions

The morphology of the Neanderthal first metatarsals and those of modern humans are quite similar. Following Trinkaus (1983a,b), the Neanderthal first metatarsals only exhibit a moderate degree of robusticity. This robusticity could be related to the shortness of the Neanderthal first metatarsals (Table 1), but unfortunately the total length of the Jarama IV metatarsal is not preserved. In our metric comparisons of first metatarsals (Table 1 and Fig. 4), it was difficult to discriminate between Neanderthals and modern humans. Neanderthal shafts presented lower values in dorsoplantar diameter than modern humans, although a high degree of variation was observed.

The morphology and dimensions of the Jarama VI hallucial metatarsal are very similar to those of recent humans and Neanderthals. The presence of the accessory articular facet for the second metatarsal and the midshaft dimensions of the Jarama VI (Table 1) fossil suggest a Neanderthal affinity, although this hypothesis remains tentative. A precise taxonomic attribution of the Jarama VI first metatarsal must await the recovery of further remains.

In Iberia, all Mousterian-related or OIS 3a human remains are ascribed to the species *Homo neanderthalensis* (Fig. 5). We therefore believe that the Jarama VI metatarsal is more likely to be from a Neanderthal than a modern human.

The taphonomic study reveals that the metatarsus was altered by a small canid. This agent has also affected a small part of all of the large mammals of Jarama, although abundant cutmarks suggest that the hominids were the main agents of transport and consumption of the herbivores.

The technological features of Jarama VI suggest expedited knapping for local materials. Coupled with the scarcity of evidence

of hearths, this suggests that visits to the site were short-term occupations during which the Jarama inhabitants obtained edges, especially without retouching, for activities related to hunting and processing fauna and possibly other functions.

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