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News and Views

CV-0, an early Pleistocene human phalanx from Cueva Victoria (Cartagena, Spain)

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Introduction

Presence of humans in the early Pleistocene deposits of southeastern Spain was first noted at the localities of Orce (Gibert et al., 1983) and Cueva Victoria (Pons-Moyà, 1985; Gibert and Pons-Moyà, 1984). Administrative difficulty of working at Orce during the last 20 years has been the main obstacle to increasing the fossil collection from these sites. Three fragmentary human remains were collected from the site of Venta Micena prior to 1989, and these remains have been characterized as human by both anatomical (Gibert et al., 1983, 1989a, b, c, 1991, 1992a, 1994a, b, 1998a, 1999a, b, c, d, 2001, 2002, 2006; Campillo, 1989, 1999, 2002; Campillo and Barceló, 1989; Sánchez et al., 1999; Gibert and Palmqvist, 1995; Campillo et al., 1996, 2003; Gibert, 2004) and immunospecific methods (Borja et al., 1997; Lowenstein et al., 1999; Torres et al., 2002) (for an independent evaluation, see Tobias, 1998). One of these human specimens, an infant skull fragment (VM-0), has been controversial, and some of the authors who originally noted its human affinity later assigned it to an equid (Agustí and Moyà-Solà, 1987; Moyá-Solá and Kohler, 1997) or to a ruminant (Martínez-Navarro, 2002). Both opinions were based on limited evidence. Recent discovery (Campillo et al., 2006) of a juvenile skull of Roman age with a conmensurable internal occipital crest refutes the central argument against the attribution of VM-0 to *Homo*, and this new anatomical data, together with the immunospecific assignation (Borja et al., 1997), should finish the controversy. Human occupation in this part of Europe during the early Pleistocene is also indicated by the presence of large collections of Oldowan tools in the Orce basin, which were first described by Gibert et al. (1992b), Roe (1995), and Tixier et al. (1995). Excavations led by J. Gibert in 1995 at the sites of Barranco León and Fuentenueva-3—both of similar age to Venta Micena (Scott et al., 2007)—produced a large collection of tools (Gibert et al., 1998b, 2001, 2006). Furthermore, a human molar fragment (BL-0) was identified at Barranco León (Gibert et al., 1999c). Despite this growing body of evidence, Martínez-Navarro et al. (2005: 517) argued that ''intense controversy over several fossil specimens found in southeastern Spain at Orce and Cueva Victoria have (sic) seriously confounded this debate, rendering dubious the hypothesis of an early human occupation of this area.'' This paper replies to claims made by Martínez-Navarro et al. (2005) that one of the Cueva Victoria fossils, the phalanx, belongs to *Theropithecus oswaldi*.

Martínez-Navarro et al. (2005) criticized classification of CV-0 as a human phalanx, claiming it to be an intermediate pedal phalanx of *T. oswaldi*. Their claim is based on two alleged mistakes: ''First, although it was published as a complete specimen, it corresponds to a juvenile or subadult individual, as it does not preserve the proximal epiphysis, which had not fused at the time of death. Second, the fossil was not

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compared with *Theropithecus oswaldi*" (Martínez-Navarro et al., 2005: 519). According to Martínez-Navarro et al., CV-0 has four features that distinguish it from *Homo*. However, their claim is not sufficiently supported by evidence (measurements, detailed photography, X-rays, etc.). Below we discuss these four features and supply evidence that support the identification of CV-0 as an adult human manual phalanx and exclude it from *T. oswaldi*.

The two supposed mistakes

First mistake

Martínez-Navarro et al. (2005) stated that CV-0 (Fig. 1) belongs to a juvenile or subadult individual. In modern human manual phalanges, the proximal epiphysis becomes fused by 16.5 years (the age of fusion for the middle manual phalangeal bone is 14–14.5 years in women and 16 years in men according to Scheuer and Black, 2000, 334–8; by 19 years all phalangeal epiphyses have become fused according to Williams and Warwick, 1985; Fig. 2). Before to this age, phalanges are poor in bone tissue and the epiphyses are unfused. Of particular interest

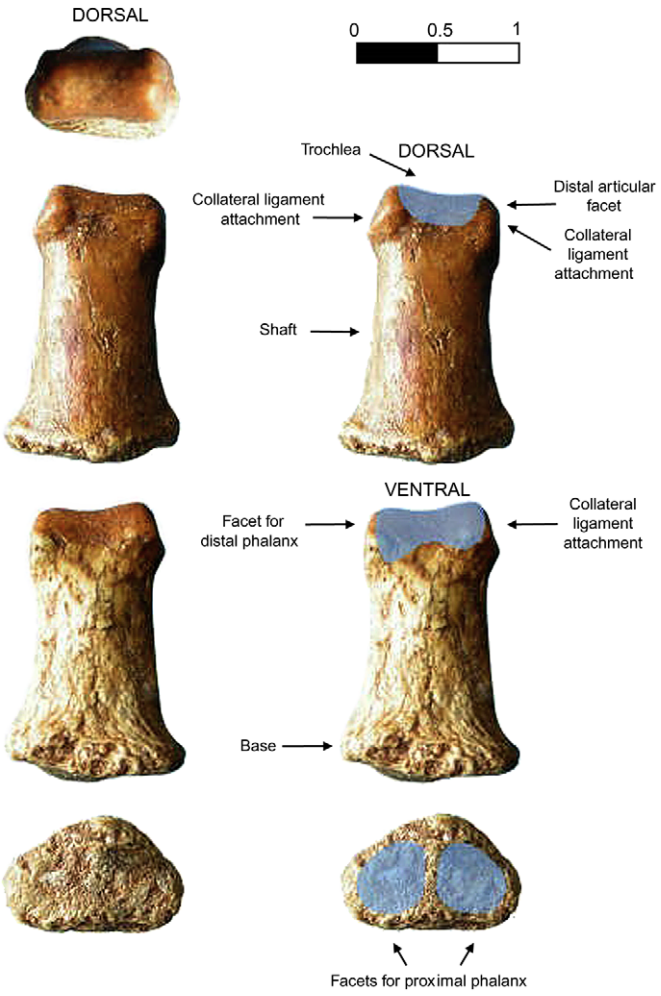

Fig. 1. Different views of CV-0, showing its anatomical features. Scale bar = 1 cm.

Fig. 2. X-ray photographs showing the ontogeny of human phalanges in the third digit (from Williams and Warwick, 1985). During juvenile and subadult stages, the shape of the phalanx is immature, poor in bone tissue, and the epiphysis is unfused.

is the shape of the proximal epiphysis, which in juveniles is subrounded and smooth, lacking ridges on the external surface. In adult intermediate phalanges, the proximal facet has a subtriangular shape (Fig. 3) and exhibits a marked ridge on its external surface, which is evidence of epiphyseal fusion. As shown in Figs. 2 and 5, CV-0 has a fused epiphysis, which indicates that it is an adult human middle phalangeal bone. In addition, CV-0 possesses proximal articulation facets. Although these facets are poorly marked, this condition is typical of intermediate phalanges from the fifth digit of modern humans.

Second mistake

The CV-0 phalanx was not compared to the fossil phalanges of *T. oswaldi* or *H. erectus* or *H. habilis* because they were not available. However, it was compared to juvenile and adult manual and pedal phalanges of *H. sapiens*, *H. neanderthalensis*, *Australopithecus*, and modern cercopithecoids (Gibert et al., 1985; Gibert and Pérez-Pérez, 1989; see also Pérez-Pérez, 1989; Palmqvist et al., 1995, 1996; Santamaría and Gibert, 1992).

If, as Martínez-Navarro et al. (2005) argued, CV-0 is a *T. oswaldi* subadult phalanx, then it should be compared with subadult phalanges of *T. oswaldi*, not with adult phalanges, which have larger dimensions. However, the supposedly

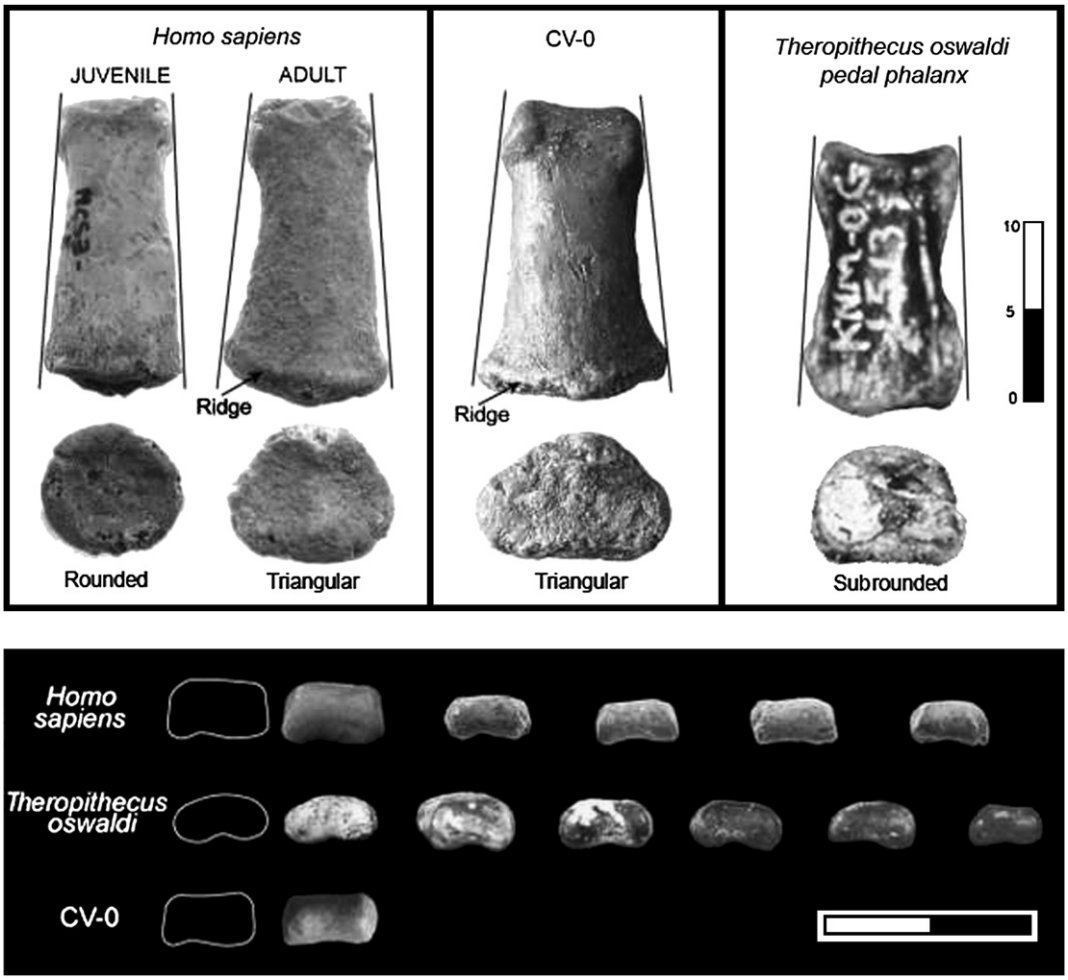

Fig. 3. **Above:** Comparison between the dorsal and proximal faces of juvenile and adult left intermediate manual phalanges (fifth digit) of a *H. sapiens*, CV-0, and the intermediate pedal phalanx of *T. oswaldi* (from Martínez-Navarro et al., 2005). The circular shape of the proximal surface in juvenile human individuals changes to triangular in adults, which is very similar to CV-0 and different from *T. oswaldi* (subrounded). Note the marked ridges on the external surface of the proximal epiphysis in the adult *H. sapiens* and CV-0, which indicate epiphyseal fusion. **Below:** Comparison between the distal trochleae of the intermediate phalanx in fifth digit of *H. sapiens*, pedal phalanges of *T. oswaldi* (from Martínez-Navarro et al., 2005), and CV-0. Specimen CV-0 exhibits the human pattern, which is different from the bean-shaped pattern observed in *Theropithecus* trochleae. Scale bars = 10 mm.

juvenile phalanx CV-0 is larger than all of the manual phalanges and a majority of the adult pedal phalanges in the *T. oswaldi* sample used by Martínez-Navarro et al. (2005), and only 1.1 mm shorter than the largest pedal phalanx. As measured in Fig. 2, the unfused epiphysis represents between 14% and 16% of the total length of the juvenile manual phalanx. If the epiphysis of CV-0 is unfused, as Martínez-Navarro et al. concluded, then the measurement of CV-0 given by these authors represents only about 85% of the complete phalanx. To make a more appropriate comparison with adult phalanges, 2.44 mm (i.e., 15% of CV-0's length) should be added to the CV-0 phalanx to account for the epiphysis, and when this is done, CV-0 falls outside the *T. oswaldi* range of variation.

Martínez-Navarro et al. (2005: 521) also relied on a juvenile age for CV-0 to explain why the proximal transverse diameter of CV-0 is larger (10.4 mm) than the largest specimen of *T. oswaldi* (9.9 mm): "the proximal transverse diameter of CV-0 is a bit larger … probably because the Spanish fossil is from a juvenile or subadult individual with the proximal epiphysis unfused." However, if CV-0 was a juvenile individual, then the measurements of the proximal transverse diameter would increase, not decrease, with age, accentuating the size difference between it and the *T. oswaldi* sample.

The four diagnostic features

The trochlea

According to Martínez-Navarro et al. (2005: 519–520): "In *Homo*, the distal trochlea of the intermediate phalanx is typically marked by a groove on the palmar face, but in CV-0, the shape of the distal trochlea is more cylindrical." However, our observations and measurements show that the distal part of the trochlea on its palmar face is slightly curved in humans, as it is in CV-0, but not in specimens of *T. oswaldi*, in which the sulcus is not as marked and is located in the center of the trochlea, producing a bean shape (Fig. 3). In fact, what Martínez-Navarro et al. (2005) clearly show is that the distal trochlea of CV-0 is very different from the trochlea of *T. oswaldi*. We conclude that the trochlea of CV-0 is human in its anatomy (Fig. 3).

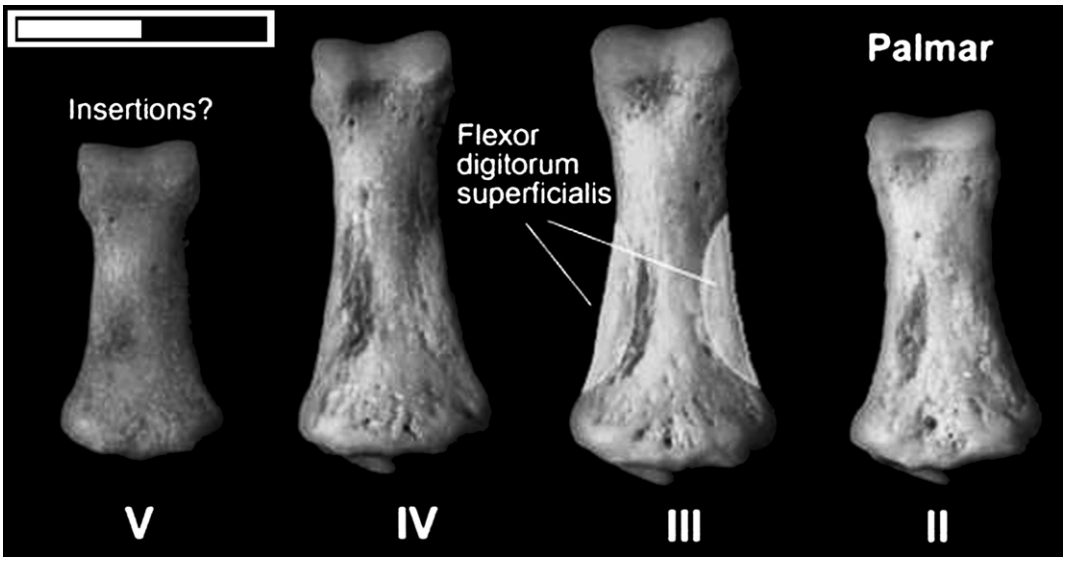

Fig. 4. Differences between human intermediate phalanges from different digits (taken from Martínez-Navarro et al., 2005). The picture shows the large differences in sizes and muscle insertions between intermediate phalanges from digits 2–5. In the fifth intermediate phalanx, the insertions for flexor digitorum superficialis are not marked, as in CV-0. Scale bar = 2 cm.

The muscle insertions

According to Martínez-Navarro et al. (2005: 520): "in CV-0, the insertion for flexor digitorum superficialis extends along the complete length of the lateral borders of the diaphysis, but in *Homo*, this insertion is located more proximally and there is a small gap between the muscle insertion and the trochlea." Martínez-Navarro et al. did not provide the necessary information to back up this claim, and according to our direct observations on the fossil (see Fig. 1), these insertions are poorly marked in CV-0, as they are in the fifth digit of humans, in contrast to the condition in the other fingers (Fig. 4).

The subparallel borders

"In dorsal view, the medial and lateral borders of the middle phalanges of *Homo* are more convergent distally than in the CV-0 specimen, which are subparallel" (Martínez-Navarro et al., 2005: 520). In adult intermediate human phalanges, the proximal articulation facet is wider than the distal (trochlea) in dorsal and palmar view, and thus the borders of the phalanx are not parallel. In subadult human phalanges and *Theropithecus* these lines are subparallel but in CV-0 they are convergent, as in adult human phalanges (Fig. 3). This observation is the opposite of what Martínez-Navarro et al. (2005) described, as indicated by the proximal (PDT) and distal transverse dimensions (DTD) given in Table 1. In human phalanges and CV-0, there is a noteworthy difference between PTD and DTD, which produces convergent medial and lateral borders. Based on the measurements given by Martínez-Navarro et al. (2005), there is a 2.5-mm difference in the case of CV-0, which is the same as the value for modern human fifth intermediate phalanges (Table 1), whereas for cercopithecoids, the mean value is only 1.2 mm and 1.3 mm in the intermediate phalanges from the hand and foot, respectively (Table 1).

Table 1
Comparison between values of length and proximal (PTD) and distal transverse diameters (DTD) of intermediate manual phalanges (fifth digit) of modern humans, Neanderthals, *Australopithecus*, intermediate pedal and manual phalanges of *T. oswaldi* (undistinguished digits), and CV-0

Phalanges[a]	*n*	PTD			DTD			Difference (PTD – DTD)	Length			DTD/PTD
		Max	Mean	Min	Max	Mean	Min		Max	Mean	Min	
Modern humans	23	12.8	11.6	7.5	9.8	9.1	5.0	2.5	23.5	19.6	15.9	0.784
Neandertals	12	14.2	10.7	7.7	11.7	8.9	6.5	1.8	23.2	18.6	13.6	0.831
Australopithecus	1		9.7			7.8		1.9		18.5		0.804
T. oswaldi												
Pedal	23	9.9	9.0	7.4	9.2	7.7	6.4	1.3	17.4	14.7	10.4	0.855
Manual	8	8.5	7.7	6.0	7.8	6.5	5.5	1.2	14.0	12.3	9.0	0.844
CV-0[b]	1		10.4			7.9		2.5		16.34		0.759

[a] The data for the fifth intermediate phalanges of modern humans, Neandertals, and *Australopithecus* are from Gibert et al. (1985); data for *Theropithecus* are from Martínez-Navarro et al. (2005), who measured intermediate phalanges of *Theropithecus* without distinguishing individual digits, and thus their mean values mix phalanges from different digits.

[b] Note that CV-0 is similar to *Homo* in values for PTD – DTD and DTD/PTD, indicating convergent medial and lateral borders. In contrast, the phalanges of *Theropithecus* have subparallel borders.

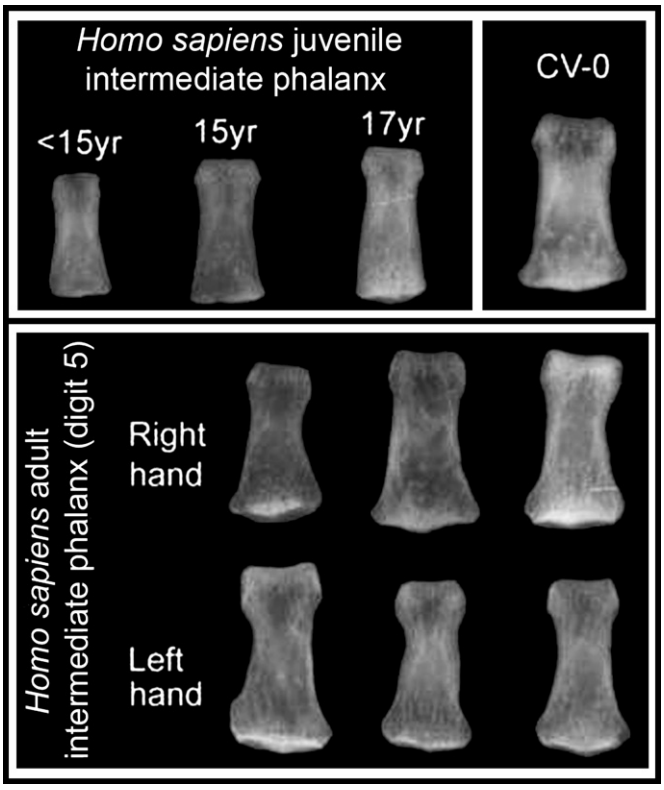

Fig. 5. X-ray photographs showing the juvenile and adult intermediate phalanges of *H. sapiens* and CV-0. This figure shows that (1) the distribution of cortical bone in the adult phalanges of *Homo* is very similar to that in CV-0; (2) the juvenile phalanges do not exhibit a ridge on the proximal face, unlike those of adult *H. sapiens* and CV-0; and (3) the lateral borders on *H.sapiens* phalanges are not symmetrical, and CV-0 exhibits a similar pattern.

The tubercles

"CV-0 exhibits lateral tubercles near the proximal base, which is unusual in immature human phalanges" (Martínez-Navarro et al., 2005: 521). This criticism is only valid for subadult phalanges, and is therefore irrelevant to CV-0 (an adult phalanx with proximal articular facets and no lateral tubercles; Fig. 1).

The measurements

Martínez-Navarro et al. (2005) undertook metrical comparisons between CV-0 and intermediate phalanges from the hands and feet of *Theropithecus* without considering the differences between each digit and concluded that CV-0 falls within the range of values for the cercopithecoid foot bones. This sole instance of coincident metrical values for CV-0 and *Theropithecus* is insufficient to exclude CV-0 from *Homo*. The CV-0 measurements also fall within the wide human range of variation. Gibert et al. (1985) studied 36 intermediate phalanges of the fifth digit from *H. sapiens* (23 individuals), *H. neanderthalensis* (11 adults, 1 infant), and *Australopithecus* (1 individual, A.L. 333-115) (Table 1). The range of variation among these specimens for the length of the fifth digit in *Homo* is 13.6–23.5 mm. Specimen CV-0 falls within this range (16.34 mm). The PTD and DTD parameters from CV-0 fall in the range of variation of modern humans and Neanderthals (Table 1). The equivalent human phalanx shown by Martínez-Navarro et al. is 26.4 mm in length, a value that surpasses the maximum in our sample (Gibert et al., 1985). Thus, Martínez-Navarro et al. (2005) chose an extreme example to accentuate the differences between *Homo* and CV-0.

Other anatomical differences between CV-0 and *Theropithecus*

There are morphological differences between the lateral and medial borders of human and *Theropithecus* phalanges. Generally speaking, in *Homo* the lateral border is slightly curved, while the medial border is straight (Fig. 5), whereas in all the *Theropithecus* phalanges illustrated by Martínez-Navarro et al. (2005) and in other modern cercopithecoids (plates 2 and 3 in Gibert et al., 1985; and plate 1 in Santamaría and Gibert, 1992), both borders are equally curved. As can be seen in Fig. 3, CV-0 follows the human pattern.

Conclusions

Martínez-Navarro et al. (2005) claimed that CV-0 is a subadult phalanx with an unfused epiphysis, and they compared it with adult phalanges of *Theropithecus*. They relied on its allegedly juvenile age to explain why its proximal transverse diameter is larger than the largest example of *Theropithecus oswaldi*. However, if CV-0 is a juvenile specimen, then once it reached the adult stage, the measurements of the proximal transverse diameter would have increased, accentuating the differences between it and *T. oswaldi*. The same is true for the length of CV-0, which is only 1.1 mm shorter than the largest adult *Theropithecus* pedal phalanx with the largest proximal transverse diameter; CV-0 is far from the minimum length measurements. The anatomy of CV-0 does not "closely match" the anatomy of the pedal phalanges of *T. oswaldi*, as Martínez-Navarro et al. (2005) inferred in their paper. The attribution of CV-0 to *Homo* is supported by different morphological and internal features. All of the anatomical traits studied (Gibert and Pons-Moyà, 1984; Gibert et al., 1985; Gibert and Pérez-Pérez, 1989; Pérez-Pérez, 1989), the distribution of cortical bone (Santamaría and Gibert, 1992), and the discriminant analysis of morphological measurements (Palmqvist et al., 1995, 1996; Pérez-Pérez, 1989) indicate similarity to *Homo* and not to cercopithecoids. It is unsurprising to find some differences between CV-0 and modern human phalanges, given that Cueva Victoria is a representative of early Pleistocene *Homo*.

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