An occipital crest in an infant cranium from the Roman necropolis of Francolí (Tarragona, Spain): implications to the interpretation of the Orce skull

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In 1982, fieldwork at the Lower Pleistocene site of Venta Micena (Orce, Spain) unearthed a cranial fragment (VM-0). The fragment consisted of the posterointernal part of both parietals and the adjacent portion of the occipital squama, which were exposed only on their exocranial surface. On the basis of its bone thickness, curvature and the impressiones digitatae partly visible on the inner side, we concluded that the fragment belonged to a 5-year old child. In 1984, the removal of the limestone hiding most of its inner face revealed the impressiones digitatae characteristic of a 5-year old as well as a sulcus of the sinus sagittalis superior flanked by a 6-mm high left crista marginalis. Although both features fall well within the variability of the human suprainiac occipital squama, the presence of a marginal crest beginning at lambda and bordering the sagittal sinus was regarded by some as incompatible with Homo. Here we present a recently discovered 2-year old child skeleton in a 4th-century Roman necropolis from Spain with a practically identical crest. This infant cranium (LP-511) has a nearly intact lambdoid region with an 8-mm high left crista marginalis bordering the sulcus sinus sagittalis as it turns to the right. In both VM-0 and LP-511, the sinus sagittalis veers to the right to become sinus transversus, as often occurs in the genus Homo. However, their sinus sagittalis sulci begin turning at lambda instead of at endinion, which is much more common. The newly found Roman specimen confirms that internal occipital crests may and do occur in normal human skulls and, therefore, its presence in the Orce specimen can not claimed to exclude it from the genus Homo.

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Introduction

Since the beginning of the 20th century, anatomists have been aware of the great variability exhibited by the internal occipital squama in human crania, which is especially pronounced in the suprainiac area. This zone, called also neo-occipital, is unique to the primates and reaches its greatest extension in humans (Delattre and Fenart, 1960). It stems from connective tissue, thus contrasting with the cartilaginous nature of the infrainiac squama. The morphologic variability is mainly due to the impressions left by venous sini of the dura mater either as sulci or cristae (Campllo and Barcelò, 1985, 1989; Le Double, 1903), although the internal occipital squama may sometimes be smooth. The anatomic data presented here help to clarify two points. One is anatomical, showing that within the morphological variability of the endocranial suprainiac squama it is possible to observe crests marginal to the sulci of the sinus sagittalis superior. The other is pa-
laeoanthropological, demonstrating that the presence of such a crest in a cranium is no reason to exclude it from the genus Homo.

The infant cranium from Orce (VM-0)

In December 1982, a team led by the palaeontologist Josep Gibert discovered a cranial fragment (VM-0) at the Lower Pleistocene site of Venta Micena (Orce, Granada, Spain). The fossil exhibited on its exocranial surface the posterointernal portions of both parietal bones as well as the vertex of the occipital squama (lambdoid region). Due to a calcareous concretion, only a small triangular area of the internal face of the left parietal was visible, but it showed clear *impressiones digitatae*. The fragment presented several taphonomical fissures, the most anterior of them leading to a slight deformation of the fragment.

Early in 1983 we examined the fossil and, based on its exocranial morphology, curvature, low thickness and the *impressiones digitatae* on its endocranial face, we concluded that it belonged to an infant around five years old. We were not so much surprised by the morphology but by the fact that the fossil came from Lower Pleistocene deposits dated to about 1.5 millions years BP. The implication was clear: we were dealing with an early form of *Homo sp*. Up until May 1984, all the palaeoanthropologists that had examined the fossil, some of great prestige, had agreed with our conclusions. It was suggested then that the limestone concretion on the endocranial side should be removed, which was done with great care by a technician from the Archaeological Museum of Catalonia (AMC) without any damage or deformation of the fossil. The endocranial face of VM-0 revealed a series of pronounced *impressiones digitatae*, which are typical of an infant of that age (Shapiro and Janzen, 1960). The *sinus sagittalis superior* imprint was 9 mm wide. It veered to the right at lambda, followed on its left side by a marginal crest reaching 6 mm high (measured from the exocranium to its peak). The occurrence of the crest did not change our opinion about the fossil, given the great variability of grooves and crests generally associated with the *sinus sagittalis* region (Gibert *et al.*, 1989). However, the presence of this high marginal crest

![Figure 1. Complete skeleton (LP-511) found at the roman necropolis of Prat de la Riba (Tarragona, Spain)](image-url)
Figure 2. Comparison between the fossil cranial fragment from Orce (VM-0) and that of the child (LP-511) from the Roman necropolis of Francoli. A) Endocranial face of VM-0. B) Endocranial face of LP-511. C) Detail of the marginal crest of VM-0. D) Detail of the marginal crest of LP-511, in oblique projection: (ss) sagittal suture; (ls) lambdoid suture; (la) lambda; (mc) marginal crest; (tw) taphonomical wear; (v) vertex of the marginal crest. The impressiones digitatae of VM-0 are more distinct than in LP-511, which corresponds to its age.
prompted the suggestion that such a structure could not occur in a *Homo* specimen and that the cranial fragment probably belonged to an *Equus* aged 2-3 months (Agustí and Moyà-Solà, 1987). This interpretation was accepted by certain palaeoanthropologists, including some of Gibert’s collaborators. The equine specialist Einsemann (1980, 1999), has pointed out that not a single cranium from *E. altidens* and nor even one endocranium from *E. stenonis* are known to palaeontologists.

Since we continued to believe our original conclusion to be correct, based in the experience of the first author as a neurosurgeon, we carried out a thorough revision of the anatomical literature and studied 727 human crania and dozens of equine skulls and showed that similar, though not identical, crests occur in humans today (Campillo, 1989, 1998, 2002; Campillo and Barceló, 1985, 1989). Some of the studied skulls showed marginal crests of variable heights. In another study of six modern child skulls, all of them presented similar marginal crests (Campillo and Barceló, 1985, 1989). Furthermore, after the publication of a book by Campillo (2002), thoroughly defending and arguing for the initial *Homo sp.* hypothesis, there has not been any contesting scientific comments.

**The 4th-century Roman infant (LP-511)**

The excavations carried out in 2003 at the Francolí Necropolis (Tarragona, Spain) unearthed about 30 individuals, including the skeleton of an infant in tomb 1101 that was labeled LP-511 in the Laboratory of the AMC (Figure 1). Recently, while studying the remains from this necropolis, we noticed that the endocranial morphology of the LP-511 individual was identical to that of the VM-0 fragment (Figure 2). The remains in question belonged to a nearly complete and fairly well preserved skeleton of an infant. The neurocranium is disarticulated and fractured with some erosion. However, much of the cranial vault is preserved,
thus allowing us to observe that the metopic suture is nearly closed. On the inner face of the frontal bone one can clearly discern the 4-mm wide *sinus sagittalis* groove (Figure 3). The post-romedial portions of both pariets are preserved joined at the vertex of the occipital squama (lambdoid region) (Figure 4). Both lateral portions of the foramen magnum and the occipital condyles are also preserved (Figure 5).

The remaining fragments of both temporals and pariets do not permit further reconstruction, but it is worth mentioning that a small occipital fragment including the endinion is preserved (Figures 5 and 6). There are no other bones from the splanchnocranium except the mandible, which is badly preserved. Fortunately, all its dentition is extant, which has been very useful in determining the individual’s age (Figure 7). The postcranial skeleton is nearly complete and in good preservation state.

We estimate that individual LP-511 died around the age of two years, based on the dentition (Ubelaker, 1989), the *impressiones digitatae*, the state of the metopic suture and the length of the long bones (Scheuer and Black, 2000).

**Comparative analysis between LP-511 and VM-0**

The parieto-occipital blocks of LP-511 and VM-0 have broken in nearly identical manner and show great similarity in their features (Figure 2). Surprisingly, differences are minor and can be easily explained by the different nature of the two specimens (age, chronology, species). Their main characteristics are compared in Table 1 and Figure 8. In LP-511 the preserved portion of the pariets is broader on the left side than on the right side, while in VM-0 is the other way around. The curvature of the cranial vault is somewhat more pronounced in LP-511 than in VM-0, probably due to a slight platycephaly of the latter (Figure 2).

Both marginal crests lie on the left side of the *sulcus sinus sagittalis*, that of VM-0 being slightly broader at the base. As can be seen in Figure 4, the marginal crest of LP-511 probably continued further, but it has been truncated by postmortem damage.
Discussion

Our previous study of 727 human crania of diverse typology, sex and age demonstrated the great morphological variability of the endocranial occipital squama, especially in the suprainiac area. We were able to distinguish a total of 17 secondary typologies with respect to the presence of grooves and marginal crests associated with the venous sinuses (Campillo and Barceló, 1985, 1989) as well as the occurrence of such structures as the torcular (5.08%) and vermian (3.9%) fossae. We observed that, generally the right sinus transversus tends to be a continuation of the sinus sagittalis superior and its volume is greater than that of the left sinus transversus. Both sini transversae tend to start off from the confluens sinus, located somewhat above the endinion. There is seldom blood mixing in the confluens sinus because the blood proceeding from the large sinus sagittalis superior, which receives blood proceeding from much of the brain hemispheres, generally drains through the right sinus transversus. On the other hand, the blood reaching the left side tends to come from the sinus rectus, which in turn receives the blood from the basal encephalic structures. For this reason, the right jugular vein tends to hold a greater blood flow than its left counterpart. These circulatory physiological data are important because a voluminous sinus sagittalis superior generally implies a large telencephalon. This is the case in Homo sapiens sapiens, whose sinus sagittalis superior tends to have a breadth of 9 mm (Testut and Laterjet, 1944).

In Palaeoanthropology, a visible sulcus sinus sagittalis superior may serve as an indicator of telencephalon volume. Generally, the cross-section of the sinus sagittalis approaches an equilateral triangle with convex base

Figure 6. Occipital fragment corresponding to the endinion (LP-511): (R) right side; (SSST) Sulcus of the left sinus sagittalis trasversus; (IOC) Inferior occipital crest

Figure 7. Detail of the dentition of LP-511, suggesting an approximate age of 2 years old
and concave sides, and the imprint on the occipital squama is a concave groove. On the other hand, only 37% of the 62 adult *Equus* specimens previously studied had visible *sinus sagittalis superior* imprints, but their breaths fell within 2-5 mm making their cross-section areas rather small, which is in agreement with equine brains.

Returning to *Homo*, when the *sinus sagittalis superior* makes its turn before reaching the endinion, it does it at lambda and it is difficult to tell where the *sinus transversus* begins (Campillo, 2002; Campillo and Barceló, 1985, 1989; Hollinshead, 1961; Le Double, 1903; Shapiro and Janzen, 1960). We have been able to assess in our angiographic studies of 49 human crania that this anomaly does not seem to be associated with any pathologies. Furthermore, it was possible to observe that it is generally associated with marginal crests, which, when it is a single one, it follows the border of the sulcus that is opposite to the direction of the turn (Campillo, 1998, 2002, 2004; Campillo and Barceló, 1985, 1989; Campillo et al., 2003). This feature exists in both VM-0 and LP-511, where the sagittal sinuses turn to the right at lambda and their *cristae marginalis* occur on the left border of the sulci (Figure 5 and 8). Our anatomic description is confirmed by the small occipital fragment preserved from LP-511, which includes the endinion. We can observe the characteristic elevation of this structure and, in its left side, the beginning of the *sulcus sinus transversus* with the absence of the *sinus occipitalis inferior* (inconstant sinus).

As we have been able to observe, when the *sinus sagittalis* is curved, as in LP-511, it does not belong to the *fossa torcularis*. A similar morphology can be seen in the Swanscombe skull and also in *H. neanderthalensis* (Piveteau, 1957). We should bear in mind that the volume of the *sinus sagittalis superior* holds a direct proportion with brain size. Furthermore, that in *Homo sapiens* the breadth of the sulcus at lambda is similar to that of VM-0 (9 mm), which is due to the fact that the brain size of a 5-year old is nearly that of an adult (Jennett, 1981). The breadth of the sulcus in LP-511 is only 8 mm, but its age is only 2 years. It is also worth mentioning that the *impressiones digitatae* are more pronounced in VM-0 than in LP-511, as would correspond to their respective ages.
of 5 and 2 years (Shapiro and Janzen, 1960). It is interesting to observe that the curvature of the vault in LP-511 is greater than in VM-0. This is partly due to the difference in ages, but also because there is a slight flattening of the vault in early Homo (Tobias, 1991).

The occurrence of cristae marginalis had not posed any problems to anatomists and palaeoanthropologists previous to the discovery of VM-0. We do not feel that the problem was actually the presence of a cristae marginalis but rather its high elevation and an erroneous interpretation that caused some to regard it as incompatible with Homo sp. In our opinion the presence of a high marginal crest could be related to a “sharp” turn of the sinus sagittalis superior at lambda.

Concluding remarks

The main reason used by certain scholars to reject the Orce fossil (VM-0) was the belief that internal occipital crests were incompatible with hominids. The recently discovered Roman specimen from Tarragona (Spain) confirms that such crests, though rare, do occur in otherwise normal human crania. Needless to say that this fact annuls all previous arguments made against the human hypothesis and, consequently, that the Orce specimen should not be excluded of the Homo genus.

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Bibliography


Resumen

En 1982 fue descubierto en el yacimiento de Venta Micena (Orce, España), correspondentia al Pleistoceno Inferior, un fragmento craneal (VM-0) que mostraba las regiones posterointernas de ambos huesos parietales y el vértice de escama occipital. Su cara endocraneal estaba casi totalmente oculta por una garga caliza. Según el grosor del hueso, su curvatura y las impresiones digitales parcialmente visibles en la cara endocraneal concluimos que el fragmento craneal pertenecía a un niño de unos 5 años de edad. En 1984 se procedió a la limpieza de la cara interna, que mostró unas marcadas impresiones digitales, siendo evidente la presencia del surco del seno sagital, que al llegar al punto lambda giraba hacia la derecha, presentando en su borde izquierdo una cresta marginal de 6 mm. Aunque ambas características se incluyen dentro de la amplia variabilidad anatómica habitual en la escama occipital supraíniana, algunos antropólogos opinaron que la presencia de la cresta marginal era incompatible con el género Homo. En este trabajo presentamos el esqueleto de un niño de aproximadamente 2 años de edad de la necrópolis romana (S. IV d.C.) de Prat de la Riba (Tarragona, España) que tiene una cresta marginal casi idéntica a la de VM-0. El cráneo romano (LP-511) conserva intacta la región lambdoidea con una cresta de 8 mm de altura, bordeando el surco del seno sagital. En VM-0 y LP-511 el seno sagital gira a la derecha para desembocar en el seno transverso, como frecuentemente ocurre en el género Homo. No obstante, en ambos el surco del seno sagital empieza a girar en lambda en vez de en el endinion, siendo algo poco habitual. El espécimen romano recientemente encontrado confirma que pueden encontrarse crestas occipitales internas en cráneos humanos normales, por lo que su presencia en el espécimen de Orce no puede ser utilizada como criterio de exclusión del género Homo.

Palabras clave: evolución humana, variabilidad humana, región lambdoidea, escama occipital, hombre de Orce

Una cresta occipital en un cráneo infantil de la necrópolis romana de Francolí (Tarragona, España): implicaciones para la interpretación del cráneo de Orce