

## ***Homo steinheimensis*, a comparison between the Steinheim skull and the Atapuerca Sima de los Huesos fossils**

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With the rise of the 3D Geometric Morphometrics (GMM) we often forget that, after all, GMM is about phenetics, and phenetics is not the most suitable way to make phylogenetic inferences. Cladistics is. In this paper we analyse the species *Homo steinheimensis* taking a cladistic approach. *Fortunately*, this is the only possible way to study it since the general distortion of the type specimen, the Steinheim skull, would not allow a GMM analysis. This species (created in 1936 by Berekhemer) lacks a proper diagnosis, and as such, it is not clear whether it is a valid species. However, this would not affect the cladistic analysis [1]. In the first description of the specimen, the morphology of the face was the main trait used for the phylogenetic interpretation, and this was described as sapiens-like and not Neanderthal-like. Berekhemer's conclusion was that all the traits shared by Steinheim and the Neanderthal specimens known to that date were plesiomorphies ("The other, Neanderthal-like features of the Steinheim cranium could then perhaps be explained assuming a common ancestry with Neanderthals through an older lineage"). Today, practically nobody argues that Steinheim belongs to the Neanderthal clade, as a sister group of the latter "classic" Neanderthals [2]. But the remarkable "sapiens-like" morphology of the Steinheim face is either neglected or attributed to postmortem deformation. Rak considered that the Steinheim face displayed a generalized (primitive) pattern, as modern humans do, the condition from which the extended Neanderthal face would arise [3]. But if this is the case, who are the pre-Steinheim fossils? The specimens attributed to *Homo tautavelensis/heidelbergensis* do not show a "sapiens-like" face. No other European Middle Pleistocene fossil show such a strong maxillary flexion. Only *Homo antecessor*, and perhaps the Zhoukoudian *Homo erectus* specimens do. Could the Steinheim facial morphology rather be the product of plastic distortion? In our analysis we did not find signs of major plastic deformation in the maxillary region, so we conclude that its facial morphology cannot be attributed to it. On the other hand, the face of Steinheim is reminiscent of the Sima de los Huesos (SH) faces, although in the latter, the morphology is more derived [4]. In the rest of the features, Steinheim is generally similar to the SH specimens, in some traits slightly more primitive, in other traits slightly more derived towards the "classic" Neanderthal condition. Regarding the dentition, Steinheim shares with the SH sample the expression of classic and diagnostic Neanderthal features such as rhomboidal upper molars, with large and protruding hypocones [5]. The M3 of Steinheim are remarkably reduced and the hypocone is absent, a pattern in common with the majority of the Sima de los Huesos and the Pontnewydd upper M3s. In contrast, Steinheim does not show the degree of M2 reduction displayed by the Sima de los Huesos population, although the strong postcanine reduction of the latter could be a particularity of this group (Martín-Torres et al., 2012). Our conclusion is that Steinheim and Sima de los Huesos, as well as other specimens such as Aroeira, Swanscombe and Reilingen can be classified together in a group that is cladistically intermediate between *Homo tautavelensis/heidelbergensis* and *Homo neanderthalensis*.

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