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- 1 As a system highly involved in metabolism, the cranial vessels are directly related to the function of the brain, skull, and face. As such, they may present adaptative answers to various constraints all over human evolution. The enclosed space of the cranium lends an opportunity to trace the vessel imprints, especially the diploic venous system, of which the evolutionary trend and taxonomic significance are largely unexplored. However, inspecting the diploic veins is an enduring challenge. The traditional method relies on invasive dissections, while the resolution of CT and MR is not high enough for displaying the details of the veins at a millimetric scale. In this context, knowledge of the anatomy and variation of the diploic system within and between hominin species is still superficial. To explore the potential of the vascular system in phylogenetic analyses, and with micro-CT scanning, we reconstruct detailed maps of the diploic veins in several specimens attributed to *Homo erectus*, *Homo neanderthalensis*, Upper palaeolithic *Homo sapiens*, as well as for the specimens with controversial taxonomic status – Maba 1 and Kabwe cranium (BH1). We propose several original characterisations of their diploic venous systems. The results from visual inspections, volume analyses, and fractal analyses reveal that the vascularisation level of the diploic veins may vary with the thickness of the diploe. The considerable intraspecific variation and large interspecific overlap make the vascularisation level unsuitable for differentiating hominin species. However, the description and analyses of how the diploic veins communicate with other neurocranial vessels (the meningeal vessels,

pericranial vessels, and dural sinuses) are of interest in phylogenetic discussions, as clear differences in the connection pattern are detectable between hominin species.

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