

THREE-DIMENSIONAL RIDDLES OF THE RADIAL WRIST: DERIVED CARPAL
AND CARPOMETACARPAL JOINT MORPHOLOGY IN THE GENUS *HOMO*
AND THE IMPLICATIONS FOR UNDERSTANDING THE EVOLUTION OF
STONE TOOL-RELATED BEHAVIORS IN HOMININS

by

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ABSTRACT

This dissertation tests a hypothesis of morphological adaptation to manipulative behaviors related to the use and manufacture of tools within the hominin lineage. The basic question, or ‘riddle of the wrist’, is as follows: do hominins show morphological commitment in the radial carpometacarpal and carpal region of the hand to tool behaviors such that a) the ancestral morphology is sacrificed, and b) the derived morphology has performance advantages for the behavior (i.e., it is better than the primitive structure with respect to the novel behavior)? If so, when, in which hominins, and in which behavioral contexts did this event most likely occur?

The three-dimensional quantitative evidence presented indicates that this ‘riddle of the wrist’ is solvable. The solution may be found in the trapezoid and the bones with which it articulates. In certain species of *Homo* (i.e., *H. sapiens*, *H. neanderthalensis*, and *H. antecessor*), the radio-ulnar expansion of the palmar aspect of the trapezoid results in supination of the trapezium such that the distal carpals are more aligned with one another. This re-alignment of the wrist occurs along with a complete re-configuration of the joint morphology in the radial carpal and carpometacarpal region. This complex of derived features shows biomechanical advantages for withstanding large forces that are directed radio-ulnarly across the palmar aspect of the wrist during strong contraction of the thenar musculature.

The morphological specialization of the radial wrist is a hallmark of *H. sapiens*, *H. neanderthalensis*, and their most recent common ancestor. The evidence presented indicates that the distinct morphology of the complex is derived in comparison with extant hominids as well as *Australopithecus afarensis*, *Australopithecus africanus*, and

Homo habilis. Given that OH7 (*H. habilis*) is associated with direct evidence of stone tools, it is tentatively concluded that at 1.75 Ma, the complex of derived features had yet to evolve in hominins. However, the evidence is clear that by 800,000 years ago the complex of derived features had evolved within at least one hominin lineage represented by *H. antecessor*. Therefore, the present evidence suggests that this important evolutionary event occurred during a temporal span characterized by Acheulian technology.