

# Evolution of the human hand shows earlier use of tools than previously documented

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Humans are fundamentally technological creatures. We depend on the manufacture and use of tools for our survival to a degree qualitatively greater than any other species. Therefore, an understanding of how and when the human capacity for technology developed is key to the study of our evolution.

Newly published research—“Humanlike manual activities in *Australopithecus*” (*Journal of Human Evolution*, Volume 196, November 2024)—indicates that the manufacture and use of tools occurred earlier than previously documented.

Until this new study, stone tools had not been found directly associated with the earliest members of the human lineage, belonging to the genus *Australopithecus*, but only with the first known members of the genus *Homo* (*H. habilis*), which evolved from *Australopithecus*. Therefore, although it was assumed that tool manufacture and use had earlier origins, specific evidence was lacking. It is likely that tools and other artifacts made from organic materials (e.g., wood, animal skins) were included in the earliest hominin technology. However, since such materials degrade over time, they are rarely, if ever, found in early archaeological sites.

Eberhard Karls and colleagues at the University of Tübingen, Germany employed an indirect method to identify evidence of early tool manufacture and use. They began with the observation that tool manufacture requires a great deal of manual dexterity and that although apes and humans both have hands, and the former do use some very simple tools (sticks and stones with little or no modification), they do not exhibit the same sophistication in tool manufacture as humans do. The researchers hypothesized that there could be physical differences in the anatomies of their respective hands that reflect the evolutionary adaptation to tool-

making undergone by the human lineage.

The team of scientists conducted detailed examinations of traces of relative stress of muscle attachments on metacarpal (finger bone) fossils, indicated by differences in surface elevation, coloration, and surface texture, from three species of early hominins, members of the genus *Australopithecus*, human ancestors that preceded the genus *Homo*, to which modern humans belong, and compared them to those of apes and modern humans.

Bone responds to increased stress on muscle attachment points due to differential use. Differences in use patterns of various muscles leave observable differences in bone architecture. Distinctly different patterns were observed between apes and modern humans.

Using this data, the researchers constructed three-dimensional models of the hands of the respective species. The study focused on differing evidence of use reflected in muscle attachment points on these bones since these would provide indications regarding the level of dexterity indicated by the degree of use which the hands of the different species were subjected.

Specimens of two *Australopithecus* species *A. sediba*, dating to about 1.98 million years ago (mya) and *A. afarensis* (3.9-2.9 mya) were found to have patterns of use reflected in the muscle attachments similar, but not identical, to those of modern humans. The other species—*A. africanus* (3.3-2.1 mya)—exhibited a combination of features including both ape and modern human patterns. The varying chronological spans suggest differing degrees of adaptation to dependence on technology between the species. This suggests that different early hominin species exhibited varying degrees of employment of technology, perhaps due to varying ecological adaptations.

The results revealed:

1) similarities between the *Australopithecus* and modern human specimens, in contrast to those of apes, supporting the interpretation that these early hominins were apparently capable of the sophisticated manipulation needed to produce and use stone tools and,

2) that there was variation in this regard among the different early hominin species, suggesting evidence of varied evolutionary adaptations.

The researchers concluded that “The frequent activation of muscles needed to perform characteristic humanlike grasping and manipulation in these early hominins lends support to the notion that humanlike hand use emerged prior to, and likely influenced, the evolutionary adaptations for higher manual dexterity in later hominins.”

The implication of these findings is that the development of stone tool technology on which human ancestors became increasingly dependent began much earlier than had previously been known. Furthermore, that the development of this capability was key to the evolution of the human lineage from early in its emergence as distinct from apes.

The earliest actual stone tool specimens known to archaeologists date to about 3.3 million years ago but lack associated hominin fossils, so their makers are unknown. Indirect evidence of stone tool use in the form of cut marks on bone are a little earlier—about 3.4 million years ago. The new research strongly supports the interpretation that species of *Australopithecus* were capable of manufacturing these earliest stone tools, predating the emergence of the genus *Homo*, at approximately 2.4 mya.

The broader implication of this research is that the evolution of technology among human ancestors began long before the physical evidence of stone tools that has so far been discovered. Furthermore, the development and employment of increasingly sophisticated technologies required not only adaptations in motor skills but also cognitive ones.

The evolution of stone tool technology and of language are likely to have been dialectically linked. Thus, the centrality of technology to human evolution is strengthened. This is not a new idea. Over a hundred years ago, Frederick Engels wrote this in “The Part Played by Labor in the Transition from Ape to Man”:

“But it is just here that one sees how great is the gulf between the undeveloped hand of even the most anthropoid of apes and the human hand that has been highly perfected by the labor of hundreds of thousands of years. The number and general arrangement of the bones and muscles are the same in both; but the hand of the lowest savage can perform hundreds of operations that no monkey’s hand can imitate. No simian hand has ever fashioned even the crudest stone knife.”



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