New fossil discovery sheds light on the evolution of the human hand

By Philip Guelpa
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A recent discovery, published in the *Proceedings of the National Academy of Sciences* (Ward, Tocheri, Plavcan, Brown, and Manthi, PNAS, Vol. 111, No. 1, pp. 121-124, January 7, 2014), provides evidence that pushes back the evolution of the human hand to more closely correlate with the appearance of sophisticated stone tools. At almost 1.5 million years old, the metacarpal bone found in Kenya is the oldest known to possess a key modern human characteristic. The discovery was made by researchers in Kenya, Britain and the United States, including Carol Ward and Kyalo Manthi.

The ability to fashion increasingly sophisticated and complex tools is a defining characteristic of modern humans and their predecessors dating back over two and a half million years. This ability results from a combination of highly developed mental faculties and manual dexterity. The archaeological record, consisting mostly of stone tools and manufacturing debris, provides material evidence of this ability. However, biological evidence of how this capacity developed is meager.

The new find demonstrates that a key anatomical adaptation, the metacarpal styloid process, appears in a specimen attributed to an early member of the genus *Homo* dating to approximately 1.42 million years ago (mya). This feature is not found in earlier hominins, *Ardipithicus* and *Australopithecus*, and was previously known only from much later fossils attributed to archaic *Homo sapiens* and Neanderthals.

Members of the genus *Homo*, including archaic and modern *Homo sapiens* as well as Neanderthals and their common ancestor, *H. heidelbergensis*, share a number of characteristics of the hand and wrist not found in earlier hominins or in non-human apes. These differences are thought to have evolved as part of the increasing reliance of hominins on making and using tools. The recovery of fossil hominin hand bones has been quite rare, making the early evolution of hand morphology difficult to trace, and the new findings all the more important.

The earliest known stone tools, classified as the Oldowan industry, date to 2.58 mya in Ethiopia. However, until this latest discovery, the earliest known fossil specimens with distinctly human hand morphology dated to only 0.8 mya. By that time, hominins had been making stone tools of the Acheulean industry, which are considerably more sophisticated than Oldowan tools, for approximately a million years. This chronological disconnect between stone tools and evolved hand morphology raised the question of whether the latter was actually necessary for making advanced tools.

Oldowan tools are no more than simple stone flakes struck from a core. By contrast, manufacture of the characteristic Acheulean tool, the handaxe, requires a much more developed and controlled technique as well as an aesthetic sense of proportion and symmetry. The production of these tools presumably required a high degree of manual dexterity capable only of a hand with modern or near-modern characteristics.

A number of *Australopithecus* specimens do exhibit some modifications of the hand (e.g. shortened fingers relative to the thumb) that differ from those of apes and are thought to indicate an increased capacity to manipulate objects. These changes facilitate a more powerful opposition between the thumb and other fingers. This is consistent with the interpretation that early hominins made greater and more varied use of their hands than do chimpanzees and gorillas (and presumably their ancestors).

However, the characteristic feature of modern

humans and Neanderthals, the styloid process, a bony projection on the proximal end of the third metacarpal (the bone between the middle finger and the wrist), is not found in australopithecines, or any other apes or monkeys. This feature is thought to be an adaptation to permit complex manipulative skills as well as increased stability between the hand and the wrist.

The newly reported third metacarpal with its styloid process has dimensions equivalent to those of modern populations. This morphology does not appear to represent an intermediate condition; the evolution of this feature must therefore have occurred considerably earlier than the 1.42 mya date of this specimen.

The shrinking of the chronological gap between the appearances of sophisticated Acheulean stone tools (~1.75 mya) and evolved hand morphology (1.42 mya), based on the new discovery, lends support to the interpretation that the two were correlated in evolution and are likely to be functionally related.

Some 138 years ago, Frederick Engels, in his highly insightful *The Part Played by Labor in the Transition from Ape to Man*, emphasized the importance of the evolution of the hand in the development of the human capacity for labor.

Engels understood that the concurrent evolution of the hand with the increasing sophistication of tool production was a complex, dialectical interaction. The hand formed the tool, but the activity of tool-making itself, in the course of its historical development, altered the evolutionary trajectory of the hand.

Engels drew the conclusion: “Thus the hand is not only the organ of labor, *it is also the product of labor*. Only by labor, by adaptation to ever new operations, by inheritance of the thus acquired special development of muscles, ligaments and, over longer periods of time, bones as well, and by the ever-renewed employment of this inherited finesse in new, more and more complicated operations, has the human hand attained the high degree of perfection that has enabled it to conjure into being the pictures of a Raphael, the statues of a Thorwaldsen, the music of Paganini.”
