“No one has compared these joint angles before, mainly because it wasn’t possible to do in a quantifiable way.”
We are interested in how those surfaces relate to each other. The angles between the surfaces provide clues to how the hand can move. For example, the joint surfaces in humans allow us to round our hands and cup objects. Chimps cannot cup their hands like a human can. Their fingers are designed for gripping tree branches, not pitching a baseball. Humans can also pinch objects tightly between the thumb and the side of the index finger, the way you would hold a key while unlocking a door. Chimps and gorillas do not have this strong "pad-to-side" grip.

The software that Marzke uses lets her compare the angles found in fossil bones to those of the living primates. The software generates a plane across each joint surface and measures the angles between those planes. The researchers can compare the differences in angles within and between species.

"We can determine what fossil species were or weren't able to do based on those differences," says Marzke. "No one has compared these joint angles before, mainly because it wasn't possible to do in a quantifiable way. It was pretty much a matter of eyeballing the joints."

The new data brought some startling results. *Australopithecus afarensis*, the older species, has joint angles comparable to humans, with the resulting cupping and pinching ability. *Homo habilis*, the so-called toolmaker, has angles like a gorilla that are not as well-suited for making and using stone tools. "If the *Homo habilis* trapezium was part of a hand that was making or using tools, then the animal was doing so in a way that is very different from the way in which modern humans use and make tools," says Tocheri.

Marzke suspected these results years ago, but had no way to study them with precision. "Measuring these angles with traditional measures is extremely difficult. The surfaces are very slender, with a lot of curves and angles, making it very hard to get accurate readings," she says. "I used protractors, but they were very clumsy compared to this technology."

Tocheri adds, "If you simply eyeball the joints, when you go back in a month you might not get the same results. But these measurements can be precisely replicated."

The researchers presented their results to *American Journal of Physical Anthropology* for review. Meanwhile, they continue studying the bones for more information about how hominids may have used their hands.

You probably wouldn't name your toy poodle "Killer" or call your cat "Fido." Some names just don't fit. New research indicates that *Homo habilis* is one of them. Paleoanthropologists are the scientists who make a living studying the origins of humanity. They gave the name *Homo habilis* to the fossil bones of the first known *Homo* species. *Homo habilis* was the first hominin to be considered human. Loosely translated, the name means "handyman," because *habilis* was believed to be the first species to manufacture stone tools.

Mary Marzke has her doubts. A professor of anthropology at Arizona State University, Marzke has a few tools of her own. She used them to make a remarkable discovery. "It looks like this one called 'handyman' didn't have that particular ability," she says. He might have had the intelligence to make tools—*habilis* has a larger brain than his predecessors—but he just didn't have the hands for the job.

Debates about human ancestry rage among anthropologists. The human family tree changes as new fossils are found and new tools are developed to analyze them. Marzke is applying new technology to study the hands of primates. During recent work she examined a wrist bone called the trapezium. This bone can tell scientists a lot about the manual dexterity of people and primates. In short, it can tell us how handy we all really are.

Unlike poor *Homo habilis*, Marzke has a very advanced tool at her disposal—software that can be used to analyze three-dimensional objects, such as bones. The computer program was developed as part of the 3D Knowledge Program at ASU's Partnership for Research in Stereo Modeling (PRISM).

"The program allows us to interact with the bones. We analyze them with traditional measurements as well as with things you couldn't do using traditional techniques," says Matt Tocheri, a doctoral student in anthropology who works with Marzke.

The scientists use 3D scanners in the PRISM labs. They scan bones from modern humans, chimps, and gorillas. They also scan fossil bones from *Homo* and another hominid called *Australopithecus afarensis*. Both hominids are thought to be ancestors of today's humans. The smaller-brained *Afrormi* lived between 4 million and 2.7 million years ago in Africa. *Hablis* lived 2.6 million to 1.6 million years ago.

The modern bones provide a useful comparison group. The researchers already know what these species can and cannot do with their hands. If a hominid bone resembles a human, chimp or gorilla bone, the scientists can assume it has similar manual abilities.

Digital images are made of each bone. Researchers analyze those images using software developed by ASU computer scientists Dezhi Liu, Myungsoo Ba, and Sandee Pulka. The software provides the anthropologists an opportunity to take measurements that are difficult or impossible to make using traditional techniques. "Volume and surface area measurements are virtually impossible to obtain with traditional techniques," says Tschirch. "We always had to estimate before we had this software to help us do the work."

Marzke is also interested in the angles between joint surfaces, another hard-to-measure feature that is key to understanding the capability of a hand. "There are four joint surfaces on the trapezium," she says. "These surfaces connect to the thumb, index finger, and two other wrist bones. We are interested in how those surfaces relate to each other."

The new data brought some startling results. *Australopithecus*, the older species, has joint angles comparable to humans, with the resulting cupping and pinching ability. *Homo habilis*, the so-called toolmaker, has angles like a gorilla that are not as well-suited for making and using stone tools. "If the *Homo habilis* trapezium was part of a hand that was making or using tools, then the animal was doing so in a way that is very different from the way in which modern humans use and make tools," says Tocheri.

Marzke suspected these results years ago, but had no way to study them with precision. "Measuring these angles with traditional measures is extremely difficult. The surfaces are very slender, with a lot of curves and angles, making it very hard to get accurate readings," she says. "I used protractors, but they were very clumsy compared to this technology."

Tocheri adds, "If you simply eyeball the joints, when you go back in a month you might not get the same results. But these measurements can be precisely replicated."

The researchers presented their results to *American Journal of Physical Anthropology* for review. Meanwhile, they continue studying the bones for more information about how hominids may have used their hands.

"We found some angles that we never thought about before," says Marzke. "We found a similarity in two fossil species not found in any of the living ones. It's generated some new questions."

For more information, contact Mary W. Marzke, Ph.D., Department of Anthropology, College of Liberal Arts and Sciences, 480-585-6227. Send e-mail to mmarzke@asu.edu.