Long after some hominins were bipedal, others stuck to the trees

Enlarge / The excavation site where the bones were found.

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We already know that, at various points in our species' past, several hominin species were wandering around Africa. But now it turns out they may have been living very different lives. A team of anthropologists took a closer look at the internal structure of leg bones from two South African hominins. It turns out that around the time our genus emerged, some hominins were living the bipedal life, while others were still spending a lot of time in the trees.

Climbing in the hominin family tree

For most of the last few million years, our ancestors shared their world with several other hominin species. In some ways, most of those species looked and acted like their neighbors, but there were undoubtedly some striking differences, too. Every hominin species in the fossil record has its own unique mix of familiar human traits and more ape-like ones, shaped by their environments and lifestyles.

In some cases, we're not even entirely sure which of those species were our direct ancestors and which were more like

cousins. That complexity makes it difficult to figure out exactly when (and why) hominins stopped hanging out in trees and started walking upright.

The size and shape of different parts of a bone can reveal plenty about how an animal—or a person—lived. Some things, like the general shape of our femurs, are the product of generations of evolution, which selected the traits that were most useful for bipeds. Others are the product of a lifetime of activity, because bone remodels itself constantly in response to the stress we put on it, so denser bone tends to form where the bone is under the most pressure. But you can't see those patterns just by looking at the outside of the bone.

University of Kent paleoanthropologist Leoni Georgiou and colleagues used CT scanning to look at those patterns of bone density inside the femurs (thigh bones) of two early hominins. In particular, they looked at the femoral head—the ball of bone at the top of the femur, which fits into the socket of the pelvis to form the hip joint. That's where a lot of the weight of the body gets distributed downward through the rest of the leg and the feet, so it's an important clue about whether extinct hominins walked or climbed.

The secret lives of femurs

One of the femurs belonged to a hominin who lived roughly 2.18 million years ago and was probably either a *Paranthropus robustus* or an early member of our own genus *Homo*; there's not enough of the skeleton left to be sure, and that sediment layer in the cave contains bones from both species. The other is a 2.8 to 2.0 million year-old *Australopithecus africanus*. The two hominins lived a few hundred thousand years apart in time but at the same place, Sterkfontein Cave in what is now South Africa.

Based on their appearance, it looked like both species had evolved for a life on foot. Both were shaped a lot like ours,

with large femoral heads, long necks, and flatter condyles—the two small bulges at the lower end of the femur, where it meets the knee. That probably means that selective pressures shaped both *A. africanus* and the unidentified 2 million-year-old hominin to walk most of the time.

But it doesn't necessarily mean that's what these long-dead human relatives actually *did* on a daily basis. For example, we're evolved to walk most of the time, but very few of us do. Most of us sit much more than we walk, run, or climb, and our skeletons will tell on us someday.

The bones certainly told on the two long-extinct hominins from Sterkfontein Cave, which had surprises in store for Georgiou and her colleagues. The paleoanthropologists had expected the *A. africanus* femur to look, on the inside, more like modern apes than like modern humans. But the 2.8 to 2.0 million-year-old *A. africanus* femur from Sterkfontein had the same internal structure of bone density as modern humans. On the other hand, Georgiou et al. expected the 2.18 million-year-old hominin to have spent all its time walking and almost none in the trees, with the bone structure to match. But its internal structure surprised the researchers by looking much more ape-like.

- The ball of this femoral head fits into the socket of the pelvis to form the hip joint. This one belongs to a human. The lighter areas of the image are areas of denser bone.
- The ball of this femoral head fits into the socket of the pelvis to form the hip joint. This one belongs to an *Australopithecus africanus*. The lighter areas of the image are areas of denser bone.
  Georgiou et al. 2020
- The ball of this femoral head fits into the socket of the pelvis to form the hip joint. This one belongs to a gorilla. The lighter areas of the image are areas of denser bone.

Georgiou et al. 2020

- The ball of this femoral head fits into the socket of the pelvis to form the hip joint. This one belongs to a 2.18 million-year-old hominin. The lighter areas of the image are areas of denser bone.
  Georgiou et al. 2020

Similar evolutionary history, different lifestyles

Until fairly recently, modern humans spend most of our time with our hips extended, either standing or walking. That puts pressure on the hip joint mostly from the back, and CT scans reveal that the densest bone in a human femoral head is usually on the back surface, with something like a pillar of dense bone running through the middle, toward the femoral neck. Those reinforced pillars of dense bone appear exactly where computer models predict that normal activities put the most pressure on the bone.

In most other apes, which spend more time in trees with their hips bent, weight is carried in a different direction. As a result, the densest bone in the femoral head usually forms either a cone or a pair of pillars—one where the bone experiences the most stress when the hips are flexed for climbing, and another where the bone is under the most pressure when walking around, with the hips only partly flexed. There are some differences between ape species, based on how they move and what sort of environment they live in, and it’s actually possible to tell species apart based on the bone structure in their femoral heads.

On the outside, both of the femurs from Sterkfontein—bones from two different hominin species, separated in time by hundreds of thousands of years—were nearly identical and looked much like ours. But when it came to inner structure,

shaped by behavior in life rather than evolution, the unidentified hominin from 2.18 million years ago had a femoral head that more like modern apes than like modern humans.

A complicated family history

It’s hard to say exactly what that means, since we don’t know the younger hominin’s species for sure, or exactly where it fit into the family tree. However, it definitely spent some time in actual trees, hundreds of thousands of years after other hominins in the same area had taken up bipedalism. And two species which had clearly evolved for similar ways of life still practiced very different behavior. That means that our early cousins were a much more diverse group, both physically and behaviorally, than we’ve realized until fairly recently.

The researchers say they would like to CT scan the femurs of other early hominin specimens to help shed more light on how they moved in life. They also hope to study other bones, to better understand what their internal structure can tell us about what hominins did, rather than just what kinds of selective pressure their ancestors faced.

“Further analysis of the internal structure of other bones of the skeleton may reveal existing findings about the evolution of other key human behaviors such as stone tool making and tool use,” said study co-author paleoanthropologist Matthew Skinner, also of the University of Kent. “Our research team is now expanding our work to look at hands, feet, knees, shoulders, and the spine.”

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