

Blame backbone fractures on evolution, not osteoporosis

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Osteoporosis is blamed for backbone fractures. The real culprit could well be our own vertebrae, which evolved to absorb the pounding of upright walking, researchers at Case Western Reserve University say.

Compared to apes, humans have larger, more porous vertebrae encased in a much thinner shell of bone.

The design works well until men and women age and suffer bone loss, leaving them vulnerable to cracks and breaks, the scientists say. Apes, on the other hand, can suffer comparable bone loss as they age, but have much thicker vertebral shells to begin with so that their vertebrae remain intact.

The findings are now published in the online journal [PLoS One](#).

"In evolution we have great adaptation, but there is sometimes a tradeoff," said Meghan Cotter, an instructor in anatomy at Case Western Reserve University School of Medicine and a lead author of the study.

"The structure is great for walking around, but not good when you have osteoporosis," she said.

Cotter worked with former master's student David Loomis, from the Musculoskeletal Mechanics and Materials Laboratory in the department of mechanical and aerospace engineering; Anatomy Professor Scott W. Simpson and Anthropology Professor Bruce Latimer, both of the Center

for [Human Origins](#), and former Case Western Reserve Mechanical and Aerospace Engineering Professor Christopher J. Hernandez, who is now at Cornell University.

In his studies of early hominids, Latimer found fractures in the vertebrae of [human skeletons](#) but not in ape remains in the Hamann-Todd collection. The collection of more than 3,000 human and more than 1,200 ape specimens is housed nearby at the Cleveland Museum of Natural History.

The researchers took measurements and used CT scans, Micro CT scans and computer modeling to compare the size, shape, structure, microstructure, biomechanics and strength of the 8th thoracic vertebra from skeletons of humans, gorillas, chimpanzees and orangutans. The 8th thoracic vertebra is the one of the bones most often fractured in humans with osteoporosis.

They found that just like the broad heel bone and broad ends of the leg bones in humans, the large, porous bone of the vertebra dissipates impact. The architecture is useful for mitigating the forces of walking on two feet, protecting cartilage in joints and the discs between vertebrae.

In apes, the vertebra is shorter and wider and has a thick ring of shell around a center of porous tissue – a design well-suited to providing stability needed to climb in trees and for knuckle-walking.

Much recent research has suggested that our sedentary lifestyle and modern diet are to blame for the susceptibility to [bone loss](#) and damage.

But, looking back in time, other researchers have found the same vertebral fractures in skeletons from medieval humans in England and Africa – people who likely had an active lifestyle.

Further back, [early hominids](#) such as Neanderthals and Australopithecus have larger vertebrae like those seen in people today, but certainly had a different diet and a more active lifestyle.

The fossil record is hardly complete, but clearly in order for human forebears to become upright walkers required a major reorganization of the musculoskeletal system from ancestors that walked on all fours, the researchers say.

"We're now living about twice as long as when the adaptation evolved and that results in major problems," Cotter said. "It highlights we are not perfectly evolved specimens."

Provided by Case Western Reserve University

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