Fossil vertebrae reveal clues to evolution of long neck in giraffe

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Reconstructions of the Late Miocene giraffids Samotherium major, and a bull and cow of S. boissieri, from Late Miocene Greece. Credit: Wikipedia /CC BY-SA 3.0

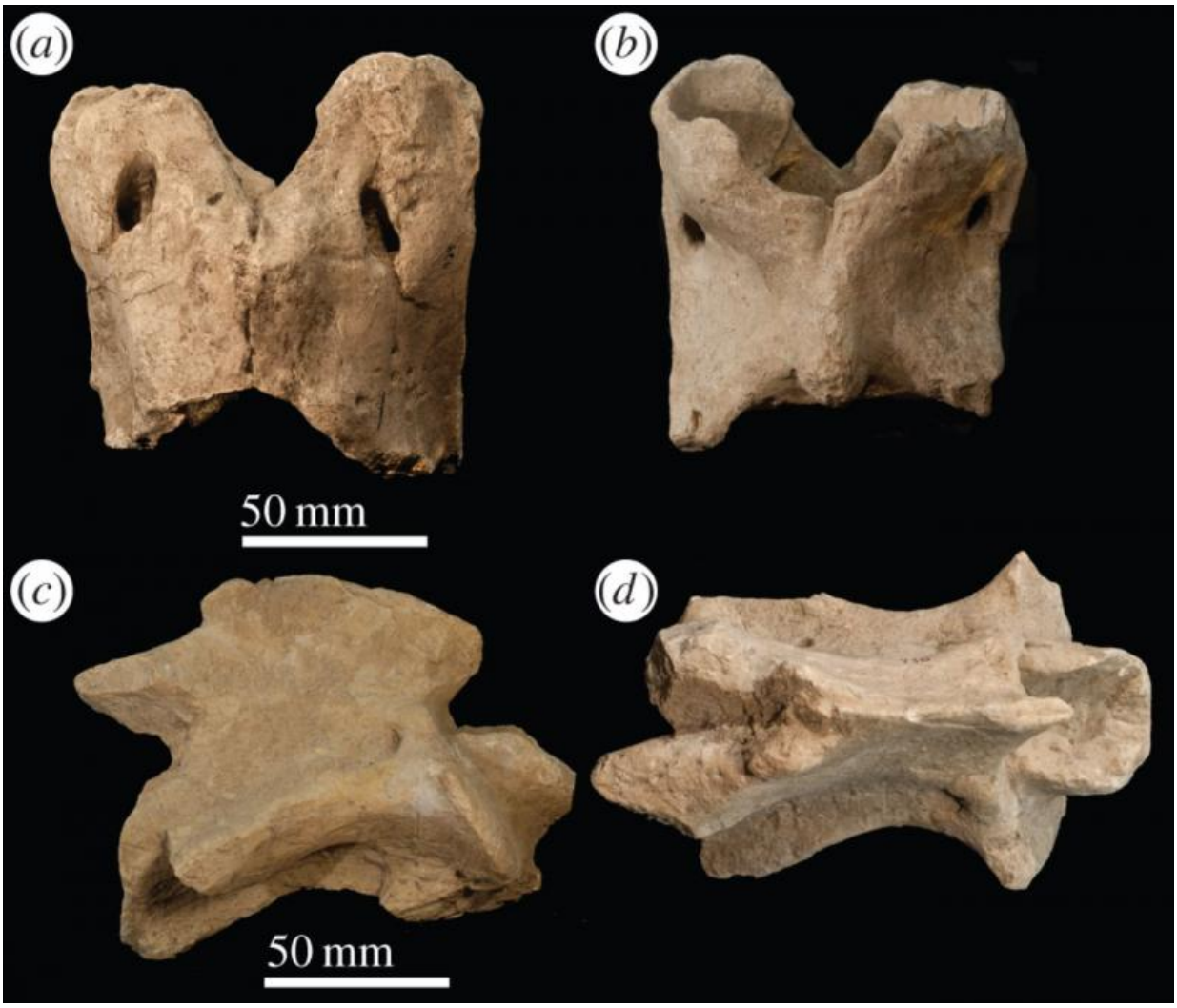
(Phys.org)—A trio of researchers with the New York Institute of Technology has pieced together the neck of the now extinct giraffe-like creature *Samotherium major* and in so doing has found some clues that help explain how giraffes evolved to have such long necks. In their paper published in *Royal Society Open Science*, Melinda Danowitz, Rebecca Domalski and Nikos Solounias describe how they managed to assemble a single neck vertebrae from bones left behind by several specimens and what they learned by comparing the fossils to the skeletal structure of modern relatives.

For many years, the researchers note, textbooks have used *S. major* as an example of evolution in progress, with a neck shorter than a modern giraffe (whose neck is on average 2 meters long), but longer than the okapi (just 60 centimeters)—the two represent its only modern relatives, both of which live in Africa—all three are members of the giraffid family. But actual fossil evidence of the evolutionary changes had been lacking, in this new effort, the researchers sought to find that confirmation.

Their study consisted of working with fossil remains that had been found on the Greek island of Samos, placing ancient vertebra together from several individuals until they had added all seven to a single unit. Once the complete neck was put together the team compared it with bones from modern giraffes and okapi.

The team reports that the neck was approximately 1 meter long, and that they found several examples of transitioning to an elongated neck, the

first of which was elongation of the back end of each of the neck bones (prior research had found elongation only on the front end of each bone). They also noted that the sixth vertebra had a completed ridge on its surface, which also partly appears on okapi vertebra but not giraffe—and the ventral lamina on the same vertebra was also comparatively transitional.



Samotherium major atlas (PIM 429) in (a) dorsal and (b) ventral views. Samotherium major axis (PIM 430) in (c) lateral and (d) dorsal views. Credit: *Royal Society Open Science*, DOI: 10.1098/rsos.150521

Taken together, the team reports that their work indicates that the neck of *S. major* represents an intermediate between the giraffe and okapi as has been believed, despite the fact that it was not a direct ancestor of the giraffe—they suggest it was closely related, enough to make the connection.

More information: The cervical anatomy of Samotherium, an intermediate-necked giraffid, *Royal Society Open Science*, Published 25 November 2015.DOI: 10.1098/rsos.150521

Abstract

Giraffidae are represented by many extinct species. The only two extant taxa possess diametrically contrasting cervical morphology, as the okapi is short-necked and the giraffe is exceptionally long-necked. Samotherium major, known from the Late Miocene of Samos in Greece and other Eurasian localities, is a key extinct giraffid; it possesses cervical vertebrae that are intermediate in the evolutionary elongation of the neck. We describe detailed anatomical features of the cervicals of S. major, and compare these characteristics with the vertebrae of the two extant giraffid taxa. Based on qualitative morphological characters and a quantitative analysis of cervical dimensions, we find that the S. major neck is intermediate between that of the okapi and the giraffe. Specifically, the more cranial (C2–C3) vertebrae of S. major represent a mosaic of features shared either with the giraffe or with the okapi. The more caudal (C5–C7) S. major vertebrae, however, appear transitional between the two extant taxa, and hence are more unique. Notably, the C6 of S. major exhibits a partially excavated ventral lamina that is strong cranially but completely absent on the caudal half of the ventral vertebral body, features between those seen in the giraffe and the okapi. Comprehensive anatomical descriptions and measurements of the almost-complete cervical column reveal that S. major is a truly intermediate-

necked giraffid. Reconstructions of the neck display our findings.