



New Analysis of *Nanotyrannus* Holotype at Cleveland Museum of Natural History Leads to Breakthrough in Decades-Old Dinosaur Debate

CLEVELAND, OH—December 4, 2025—Few dinosaur fossils have sparked as much debate and fascination as the Cleveland skull—the holotype of *Nanotyrannus lancensis*. Paleontologists have argued about the validity of this genus since it was named in 1988, and by the 2010s, many were convinced that the Cleveland skull was actually a juvenile *Tyrannosaurus rex*. Recent studies have reignited the debate, but the true identity of the holotype has remained elusive—until now, thanks to a novel idea by a Cleveland scientist that may finally unlock the mystery.

“Without additional bones from the same individual, paleontologists had no way to confirm whether the Cleveland skull had reached skeletal maturity,” said senior author and Cleveland Museum of Natural History paleontologist Dr. Caitlin Colleary. “For 80 years, researchers have tried to properly identify the Cleveland skull, and one small, overlooked bone proved to be the missing piece. Museum collections are where breakthroughs like this become possible.”

Published this week in *Science*, the study—led by Princeton University Assistant Professor of Geosciences Dr. Christopher Griffin and colleagues from institutions nationwide, including the Cleveland Museum of Natural History (CMNH)—used an innovative histological approach to reexamine the Cleveland skull, revealing the first direct evidence that it represents a skeletally mature adult.

“The holotype specimen is the fossil that defines a species, so it’s central to the debate,” said Dr. Griffin. “Showing that the Cleveland skull was fully grown is the key piece in demonstrating that *Nanotyrannus* is not a juvenile, but a distinct species from *Tyrannosaurus rex*.”

The story of *Nanotyrannus* began in the summer of 1942, when CMNH curator Dr. David Dunkle led a fossil-hunting expedition to the Hell Creek Formation in Montana. That expedition resulted in several significant finds, but none more impactful than the discovery of a skull belonging to a small carnivorous dinosaur. None of the dinosaur’s other bones were found. Although the skull resembled that of a small *T. rex*, Dr. Dunkle was uncertain of its exact identity. In 1945, the skull was sent to



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Charles Gilmore of the Smithsonian Institution, who assigned it to a new species of *Gorgosaurus*, a theropod dinosaur that lived during the Late Cretaceous Period.

Decades later, in 1988, a team including CMNH curator Dr. Michael Williams revisited the specimen. Based on its morphology, size, and the condition of its fused skull bones, they proposed it belonged to a new species entirely—a previously unknown relative of *T. rex*. They named it *Nanotyrannus lancensis*, meaning “Tiny Tyrant from the Lance Formation.” Their interpretation ignited international interest—and debate—that continued to intensify over the next three decades. As more *T. rex* juveniles were discovered, many experts challenged the validity of *Nanotyrannus*.

Dr. Caitlin Colleary, Curator and the Joan and Dan Holmes Family Endowed Chair of Vertebrate Paleontology, joined the CMNH in 2020. Shortly after she started, Dr. Christopher Griffin came to visit the collection, and a previously overlooked detail about the Cleveland skull sparked a groundbreaking idea. A small, slender bone—the hyoid, located in the throat—had broken off and was sitting in a small box next to the skull.

"We knew long bones, just like a tree trunk, can reveal the age and growth of tyrannosaurs. By examining thin slices under a microscope, we can calculate growth rates or see signals that an animal stopped growing, such as an external fundamental system (EFS). Although the skull bones wouldn't tell us the answer, we wondered if maybe the hyoid was the final piece to completing this decades-old puzzle," said co-author Dr. Zach Morris, Dinosaur Institute Postdoctoral Fellow at the Natural History Museum of Los Angeles County.

Since a hyoid had not been used to study growth before, they began by validating the technique, examining the hyoids of birds and crocodylians—dinosaur relatives still alive today. Then, using careful histological sectioning of the hyoid bone from the Cleveland skull, the team compared it to the hyoids from different dinosaurs including *Tyrannosaurus rex*, *Coelophysis*, and *Allosaurus* and were able to evaluate the microscopic structure of the bone to determine the skeletal maturity at the time of death.

The hyoid bone contained an EFS indicating that the Cleveland skull was mature at the time of death.

“By applying a new technique to a specimen that’s been in the collection for nearly 80 years, we unlocked information that’s been there all along,” said senior author Dr. Colleary. “Now we can finally say that the holotype of *Nanotyrannus* was mature, and these dinosaurs were totally out there running around with *T. rex*.”



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The Cleveland Museum of Natural History extends its gratitude to the Holmes family for generously endowing the Chair of Vertebrate Paleontology, helping to advance this field of science and make research like this possible. Their commitment to scientific discovery comes at a pivotal moment, as the Museum has been a key player in the *Nanotyrannus* story from the beginning. The specimen at the heart of the controversy is now on exhibit in the Museum's Sears Dynamic Earth Wing—serving as a powerful reminder that every bone has a story, and sometimes that story is still being written decades after discovery.

In addition to Colleary, the new paper includes contributions from Jeb Bugos, who is a Collections Manager at the Cleveland Museum of Natural History. The study also includes authors affiliated with Princeton University; Yale Peabody Museum of Natural History, Yale University; University of Nebraska State Museum, University of Nebraska; Dinosaur Institute, Natural History Museum of Los Angeles County; Ohio University; Adelphi University; Denver Museum of Nature & Science; Johns Hopkins University.

About the Cleveland Museum of Natural History

The Cleveland Museum of Natural History illuminates the world around us and inspires visitors to engage with the natural forces that shape their lives. Since its founding in 1920, the Museum has pioneered scientific research to advance knowledge across diverse fields of study and used its outstanding collections, which encompass millions of artifacts and specimens, to deepen the public's understanding of the dynamic connections between humans and nature. Through its Natural Areas Program, the Museum stewards more than 12,500 acres of protected ecosystems across northern Ohio. A community gathering place, educational center, and research institution, the Museum is a vital resource that serves Cleveland and the nation. For more information, visit CMNH.org.

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