A Whale of a Tale: Origins of Tail-Powered Swimming in Early Cetaceans
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Early Whales: Efficient Swimmers?
About 47 million years ago, the early whale Maiacetus took to the ocean, possibly to follow resources and explore new opportunities. Maiacetus was a four-legged mammal, making it relatively inefficient for a fully aquatic life.

Swimming ability for marine mammals like whales is owed in large part to tail morphology. When a tail is more muscular and has greater innervation, there is greater control, enabling the animal to have a more efficient mode of swimming.

It is debatable whether or not Maiacetus actively used its tail during swimming. The morphology of its caudal vertebrae is crucial in determining its swimming abilities. By comparing the tail vertebrae of Maiacetus with those of modern mammals, we can come to a better understanding of how this early whale swam.

Methods
- Analyzed over 70 specimens of modern mammals for comparison (both quadrupedal and fully aquatic)
- Took a length measurement of each vertebral centrum throughout vertebral column
- Took up to 9 measurements of each caudal vertebra for each specimen
- Also analyzed the fully aquatic fossil whale Dorudon for comparison
- Compared measurements of Maiacetus and Dorudon caudal vertebrae to those of modern mammals to track similarities and differences
- Ongoing work using multivariate statistical analyses to assess multiple variables for many species simultaneously

Results
- Chevrons (Hemal Arches)
  - Important structures for muscle attachment and protection of blood vessels
  - Bony structures that attach to the posteroventral aspects of caudal vertebra
  - More chevrons means greater tail control

Animals that use their tails constantly have robust musculature and much control over tail movement. For example, animals with prehensile tails have a large number of chevrons, even reaching to the end of the tail. Interestingly, Maiacetus has a large proportion of its tail containing chevrons.

What Have We Learned?
Maiacetus has a large number of chevrons, suggesting that it had significant muscular control of its tail and may have used it for swimming. Vertebral proportions were similar to those of some modern mammals. The widths and heights of its caudal vertebrae are suggestive of a possible tail fluke, though distortion of some vertebrae prevent this from being confirmed with certainty. Maiacetus likely used its hind limbs for swimming, but evidence suggests it used its tail in some way as well.

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