

## Ontogenetic changes in the craniomandibular skeleton of the abelisaurid dinosaur *Majungasaurus crenatissimus* from the Late Cretaceous of Madagascar

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Abelisaurid theropods were one of the most diverse groups of predatory dinosaurs in Gondwana during the Cretaceous. The group is characterized by a tall, wide skull and robust cervical region. This morphology is thought to have facilitated specialized feeding behaviors such as prolonged contact with prey. The Late Cretaceous abelisaurid *Majungasaurus crenatissimus* typifies this abelisaurid cranial morphotype. Recent fossil discoveries of this species include a partial growth series that allows for the first time an investigation of ontogenetic variation in cranial morphology in a representative abelisaurid. Herein we examine growth trajectories in the shape of individual cranial bones and articulated skulls of *Majungasaurus* using geometric morphometrics. Several major changes in skull shape were observed through ontogeny, including an increase in the height of the jugal, postorbital, and quadratojugal, an increase in the extent of the contacts between bones, and a decrease in the circumference of the orbit. The skull transitions from relatively short in the smallest individual to tall and robust in large adults, as is seen in other theropods. Such morphological change during ontogeny would likely have resulted in different biomechanical properties and feeding behaviors between small and large individuals. These findings provide a post-hatching developmental framework for understanding the evolution of the distinctive tall skull morphology seen in abelisaurids and other large-sized theropod dinosaurs.

**Key words:** Dinosauria, Abelisauridae, geometric morphometrics, ontogeny, skull, Cretaceous, Gondwana.

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