Jurassic Stem-Mammal Perinates and Origin of Mammalian Reproduction and Growth

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ABSTRACT

Transformations in morphology, physiology, and behavior along the mammalian stem lineage were accompanied by profound modifications to reproduction and growth, including the emergence of a reproductive strategy characterized by high maternal investment in a small number of offspring and heterochronic changes in early cranial development associated with the enlargement of the brain. Because direct fossil evidence of these transitions is lacking, their timing and sequence are unknown. Here we present the first fossil record of pre- or near-hatching young of any non-mammalian synapsid: a large clutch of well-preserved perinates of the tritylodontid Kayentatherium wellesi (Cynodontia: Mammaliamorpha). Found with a presumed maternal skeleton, the single clutch numbers at least 38 individuals, well outside the range of litter-size variation documented in extant mammals. This discovery confirms that high offspring number is ancestral for amniotes and constrains the timing of a reduction in clutch size along the mammalian stem. Although tiny, the perinates have overall skull shape extremely similar to that of adults, with no allometric lengthening of the face during ontogeny. The only positive allometries are associated with the bones supporting the masticatory musculature. Kayentatherium diverged just before a hypothesized pulse of brain expansion that reorganized cranial architecture at the base of Mammaliaformes. The association of large clutch size with isometric cranial growth is consistent with a scenario in which encephalization—and attendant shifts in metabolism and development—drove later changes to mammalian reproduction.

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