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Bone microstructure and growth patterns of early mammals

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We present results of the first studies of the bone microstructure of early mammals, based on the Early Jurassic Morganucodon, the Late Cretaceous multituberculates, *Kryptobaatar* and Nemegtbaatar, and the Late Cretaceous eutherians *Zalambdalestes* and *Barunlestes*. Our results show that the two eutherian taxa grew relatively slowly with periodic pauses in growth indicated by the presence of rest lines, while the multituberculates and *Morganucodon* had a faster rate of bone formation that suggests an overall rapid growth rate that slowed down later in ontogeny. Comparisons of the early mammalian bone microstructure with that of non-mammalian cynodonts, extant monotremes, and placentals are also made, and significant differences in the rate of osteogenesis in the various groups are documented. Our findings suggest differences in the growth rate between the multituberculates and the Mesozoic eutherians, and moreover, both groups appear to have slower growth rates as compared to modern monotremes and placentals. Our results further suggest that the determinate growth strategy typical of extant mammals evolved early in the evolution of the non-mammalian therapsids. We speculate that the sustained, uninterrupted bone formation among the multituberculates may have been an adaptive attribute prior to the K-T event, but that the flexible growth strategy of the early eutherians was more advantageous thereafter.

Key words: Mammalia, Morganucodonta, Multituberculata, Eutheria, Cynodontia, bone microstructure, growth rate, Jurassic, Cretaceous.

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