FOSSIL CEMENTUM OFFERS A WINDOW ONTO PHYSIOLOGICAL EVOLUTION AMONGST MAMMALIAFORMS AND EARLY MAMMALS

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A wealth of new fossil discoveries has revolutionised our knowledge of the phylogenetic and ecomorphological evolution of mammaliaforms and early mammals during their diversification from the Late Triassic through Mid-Late Jurassic. However, until recently, understanding of their physiological evolution has been limited by a lack of robust metrics to pinpoint their metabolic properties relative to living taxa. We have recently employed synchrotron radiation-based computed-tomographic (SRCT) imaging to study the fossilized cementum of the teeth of Earliest Jurassic mammaliaforms *Morganucodon* and *Kuehneotherium*, and count their circum-annual growth increments to estimate their maximum wild lifespan. The finding of significant negative relationships between maximum wild lifespan and mass-specific standardised/basal metabolic rates (SMR/BMR) amongst living terrestrial mammals and non-avian reptiles using phylogenetically corrected least squares regression, and significant separation of regressions for both clades, allowed us to use our mammaliaform maximum lifespans to estimate their SMR/BMR. unexpectedly long maximum lifespans for both fossils (nine years for Kuehneotherium and 14 years for *Morganucodon*) in-turn provided significantly lower estimates of SMR/BMR than extant terrestrial mammals of similar size, instead correlating with small-bodied reptiles. This suggests that, contradictory to several earlier hypotheses, the elevated endothermic BMRs of extant mammals had yet to be developed amongst the earliest mammaliaforms. We have since applied SRCT imaging to study cementum in a wide range of mammaliaform and mammal taxa from two important Jurassic faunas: the Mid-Jurassic (Bathonian) Kirtlington assemblage (UK) and the Late Jurassic (Kimmeridgian) Guimarota assemblage. This has let us study both macro-evolutionary and ecological changes in lifespan and BMR amongst and between major mammaliaform/mammal groups, and test previous hypotheses relating physiological evolution to the adaptive radiation of crown mammals in the Mid-Late Jurassic. Cementum thus offers a unique opportunity to track major patterns in mammalian physiological evolution through the Mesozoic and provide context to both documented and hypothesised macro-evolutionary patterns through this period.