Havers-Halberg Rhythms in Canis familiaris.
Russell T. Hogg¹, Timothy G. Bromage², Bin Hu²
¹Rehabilitation Sciences, FGCU;
²Basic Sciences and Biomaterials & Biomimetics, NYU College of Dentistry

Introduction

We aim to assess variation in Havers-Halberg oscillation (HHO) periodicities among domestic dogs (Canis familiaris). The HHO is hypothesized to be a hypothalamus-generated biorhythm that coordinates multiple life history variables including body size, metabolic rate, and reproductive output (Bromage et al. 2009). The periodicity of this clock varies among and within species, but not within individuals. In monkeys and apes, HHO periodicity is strongly correlated with body mass, but in lemurs this is not the case. Lemurs also have a very restricted range of HHO variation (Hogg et al. 2015). This raises the question of how HHO rhythms and body size evolution can be decoupled. Domestic dogs have high body mass variation but low variation in life history variables such as lifespan, linked to intense artificial selection for IGF1 gene sequence variants (Sutter et al. 2007) rather than neuroendocrine mechanisms such as the HHO. Based on this, we hypothesize that HHO variation in dogs 1) will be narrow considering their body mass range, and 2) will not be correlated with body mass; they will therefore resemble lemurs, providing potential insight into lemur evolution.

Materials & Methods

HHO was quantified as the periodicity, in days, between successive strie of Retzius (Retzius periodicity, RP) in 11 domestic dogs of different breeds (see Table 1). To obtain this periodicity, 24-hour growth increments (cross-striae) were counted between successive strie of Retzius on histological specimens. Data were gathered from imbedded thin sections of teeth, imaged using polarized light microscopy. For information on the interpretation of RP from histological sections, see Figs. 1 and 2. Natural logarithms (ln) of RP data were regressed against body mass and compared to prior results obtained for primates (Hogg et al. 2015).

Discussion

The hypotheses are corroborated, in that 1) dogs have a narrow range of HHO variation, and 2) dog HHO period is not significantly correlated with body mass. HHO periodicities in dogs range between 4-6 days even though our sample spans nearly 2 orders of magnitude in body mass. This may explain why dogs can have such a large size variation, yet have a fairly consistent life history package in terms of lifespan and reproductive output. I.e., IGF1 mutants explain the body size variation, but do not have an impact on HHO biology and life history, which seems not to have been affected by artificial selection. Based on our results, we predict that similar physiological mechanisms may be at play in lemurs.

Acknowledgments & References

This research funded by the 2010 Max Planck Research Award which is endowed by the German Federal Ministry of Education and Research to the Max Planck Society and the Alexander von Humboldt Foundation in respect of the Hard Tissue Research Program in Human Paleobiology.

