6. Imbricational enamel formation in Neandertals and recent modern humans

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Abstract

Aspects of imbricational enamel growth are important for two reasons. First, they may be species-typical, providing insight into taxonomic questions. Second, because dental and somatic growth are linked, aspects of imbricational enamel growth may also provide insights into species-typical rates of growth and development. The present study investigates aspects of imbricational enamel formation in Neandertal anterior teeth relative to three modern human population samples from diverse regions (Point Hope, Alaska; Newcastle-upon-Tyne, England; Southern Africa). A recent study by the same authors (Guatelli-Steinberg et al., 2005) focuses on evaluating how different Neandertals were from these modern human populations in the number of

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perikymata on their anterior teeth and in their imbricational enamel formation times. The present study integrates the results and conclusions of that study with research on imbricational enamel growth curves across deciles within anterior teeth and the pattern of imbricational enamel growth across anterior tooth types. The central findings of the present study are: (1) Neandertal anterior teeth overlap with those of the modern human samples in mean perikymata numbers and estimates of imbricational enamel formation times; (2) the modern human population samples show greater similarity to each other than any of them do to Neandertals in their enamel growth curves across deciles within tooth types; and (3) Neandertals exhibit a pattern in the mean number of perikymata across anterior tooth types that appears to diverge from that of the modern human samples.

Introduction

The long childhood growth period of modern humans has been interpreted as an adaptation that provides time for brain growth (Sacher, 1975; Martin, 1983; Leigh, 2001; Crews and Gerber, 2003) and/or extensive learning (Mann, 1972; Gould, 1977; Bogin, 1997; Leigh and Park, 1998). The complex behaviors made possible by large brains and protracted growth provide selective advantages that accrue over the extended human lifespan (Smith and Tompkins, 1995). Thus, a reduction in adult mortality rates may have been a pre- or co-requisite for the evolution of long childhoods in humans (Trinkaus and Tompkins, 1990; Kelley, 2002; Crews and Gerber, 2003). While the evolutionary conditions and causes of human life history characteristics continue to be debated (Trinkaus and Tompkins, 1990; Bogin, 1997; Leigh and Park, 1998; Leigh, 2001; Crews and Gerber, 2003), studies of dental development in fossil hominins are providing insight into when prolonged growth periods emerged during human evolutionary history.

Across the primate order, dental and somatic development are closely linked because teeth develop as part of growing organisms. Weaning, for example, cannot take place until teeth erupt, and molars can only erupt when the jaw has grown large enough to accommodate them (Smith, 1989; Smith, 1991). Aspects of dental development (such as M1 eruption) are highly correlated with the length of growth periods and brain size (Smith, 1989; Smith, 1991). Relative to other primates, modern humans erupt their first molars later, have larger brains, and experience extended periods of somatic growth (Smith, 1989; Smith, 1991; Smith and Tompkins, 1995). Given the relationships between somatic development, dental development and brain size across the primate order, it is not surprising that small-brained Plio-Pleistocene australopiths may have erupted their first molars two-and-a-half to three years earlier than do modern humans (Bromage and Dean, 1985) and formed their anterior tooth crowns in significantly shorter periods of time (Dean et al., 2001).

Investigations into Neandertal growth and development, however, have not yet clearly answered the question of whether Neandertals experienced periods of growth comparable to the long childhoods of modern humans. With their large cranial capacities, Neandertals might be expected to have taken a long time to grow; on the other hand, if Neandertals had short life spans, they would be expected to have grown up quickly relative to modern humans (Trinkaus and Tompkins, 1990). To date, the dental evidence bearing on this question remains equivocal. It has been suggested that Neandertal molar eruption times might have been accelerated with respect to those of modern humans (Wolpoff, 1979; Dean et al., 1986), although Neandertals and modern humans appear to share similar dental eruption patterns (Tompkins, 1996). Anterior crown formation times in the Krapina Neandertals were found to be within the modern human range (Mann et al., 1991), but crown formation times in the teeth of