Human Evolution Inferred from Tooth Growth and Development [1]

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To study human evolution [4], researchers sometimes use microstructures found in human teeth and their knowledge of the processes by which those structures grow. Human fetuses begin to develop teeth in utero. As teeth grow, they form a hard outer substance, called enamel, through a process called amelogenesis. During amelogenesis, incremental layers of enamel form in a Circadian rhythm. This rhythmic deposition leaves the enamel with microstructures, called cross-striations and striae of Retzius, which have a regular periodicity. Because enamel is not renewed throughout life like other tissues, teeth preserve the timing and details of a person’s growth and development. Thus, enamel microstructures, from living people and from fossilized teeth, can be used to reconstruct the growth, development, and life histories of current and past humans [5]. Researchers can also compare current and fossilized microstructures to trace changes in those traits over the course of human evolution [4].

Researchers use enamel microstructures to study life-history traits unique to humans [5]. Humans differ from their closest living relatives, the great apes—chimpanzees, gorillas, and orangutans—by an enlarged brain, a long life span, and an extended childhood period that delays the age at which they can first reproduce. Many researchers hold that brain size is simple to track in the fossil record, but that the length of childhood and of life span requires more complicated methods for detection. Scientists can examine enamel microstructures to estimate when life history traits, such as weaning, malnutrition, or diseases, occurred during the life of an individual. Biologists in the early twentieth century discovered that enamel develops in cycles. Even though some researchers used teeth to reconstruct the human fossil record, scientists studying human evolution [4] did not look to enamel microstructures as sources of information until late in the twentieth century.

In the mid-1980s, paleoanthropologists began to use enamel microstructures to reconstruct human evolution [4]. Previously, for fossil samples of juvenile hominids, scientists had estimated the ages at which those juveniles had died from human standards of tooth development, a practice that biased the results by reflecting the age of specimens in human years. In 1985, Timothy Bromage and Christopher Dean, of the University of Toronto in Toronto, Ontario, and University College London [6] in London, UK, respectively, introduced a way of using enamel microstructures to determine the age of immature fossil hominids without appealing to human standards. Bromage and Dean counted perikymata, the visible remnants of striae of Retzius on the surface of tooth crowns, of immature fossil hominids. To derive the age of the individuals, the researchers then multiplied the number of perikymata by seven days, the mean formation time for each line. When Bromage and Dean compared the ages of the individuals that they derived from this technique to the ages estimated from standard methods used to determine the age of a human skeleton, they noted that the human-based results significantly overestimated the ages of the samples. Bromage and Dean demonstrated that, compared to modern humans [5], hominids had much shorter growth periods for teeth, which the researchers extrapolated to growth periods for modern great apes.

In the early 1990s, Dean and his colleagues looked at enamel microstructures and showed that Homo erectus retained an enamel growth rate that was similar to earlier hominids. Their work overturned the supposed similarity in dental development between Homo erectus and modern humans [5]. Dean argued that evidence for a modern growth rate within enamel...
microstructures does not exist in the fossil record until the origins of *Homo neanderthalensis* [9], more than 100 thousand years ago.

## Sources


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- Bromage, Timothy G. [16]
- Dean, Christopher, Ph. D. [17]
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- Theories [24]

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