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How Long is a Child a Child?

Research on a Homo sapiens juvenile fossil shows that modern human developmental patterns emerged more than 160,000 years ago

An international research team led by scientists from the Max Planck Institute for Evolutionary Anthropology (Leipzig, Germany) and the European Synchrotron Radiation Facility (Grenoble, France) has found evidence that some of the earliest members of our species had evolved our characteristically long developmental period, and most likely our extended childhood, over 160,000 years ago. These findings are in contrast to studies that suggest that early fossil hominins possessed short growth periods, which were more similar to chimpanzees than to living humans. With an innovative combination of a novel application of synchrotron imaging, high-resolution microtomography, and developmental analysis, the team reconstructed tooth growth and determined the age at death of a fossil juvenile from Jebel Irhoud, Morocco. This study represents the first non-destructive approach to characterize dental development with a high degree of precision, as synchrotron images reveal microscopic internal growth lines without damage to the specimen. The team found that the Moroccan fossil child showed an equivalent degree of tooth development to living human children at the same age. These findings and other evidence suggest that modern biological, behavioural, and cultural characteristics appeared relatively late in the past six million years of human evolution.

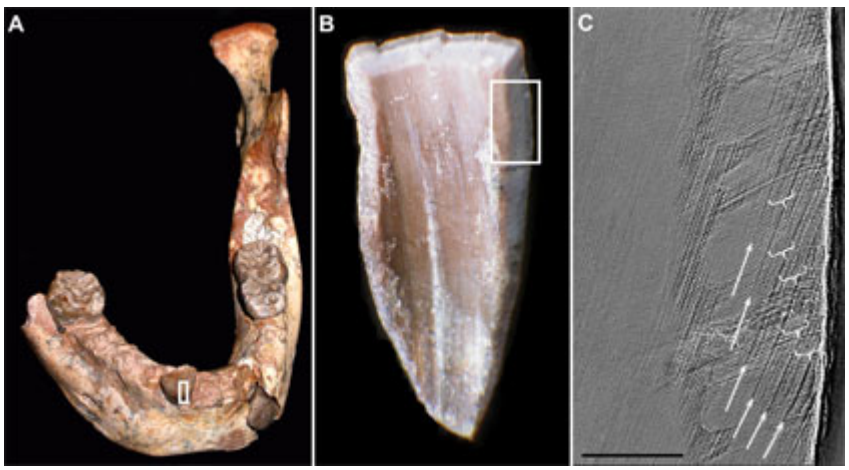

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Fig. 1: *A) The North African juvenile fossil mandible showing the location of the incisor tooth enamel (white box) sampled with the Grenoble synchrotron. B) Close up of enamel fragment, with the area of interest (on right) shown in the white box. C) Synchrotron image showing growth lines (white arrows) with 10 daily lines between them (white brackets). The scale bar is 200 microns, or 0.2 mm.*

Image: PNAS

Modern human origins continues to be one of the most hotly debated topics among anthropologists, and there is little consensus about where and when the first members of our species, *Homo sapiens*, became fully modern. While fossil evidence tells a complex tale of mosaic change during the African Stone Age, almost nothing is known about changes in human 'life history,' or the timing of development, reproductive scheduling, and lifespan. Tooth growth, and most importantly molar tooth eruption age, represents one of the most powerful clues to reconstruct growth processes in fossil humans. By using incremental growth lines in teeth, similar to annual rings in trees, developmental rate and time may be accurately established millions of years after death. Research during the past two decades has shown that early fossil humans (australopithecines and early *Homo*) possessed short growth periods, which were more similar to chimpanzees than to living humans. However, it unclear when, in and which group of fossil humans, the modern condition of a relatively long childhood arose.

Fig. 2: *The North African fossil mandible superimposed over horizontal developmental lines on an incisor tooth, with the internal daily lines shown in the black and white image on the bottom. With this non-destructive technique it is now possible to accurately and non-destructively reconstruct how fossil teeth grew and how old juvenile individuals were when they died. The circular image on the left shows the organisation of the third generation synchrotron at the European Synchrotron Radiation Facility in Grenoble, France, where the first 'virtual tooth histology' images were captured from fossil humans.*

Image: PNAS

In this study, tooth growth and eruption was examined in one of the earliest representatives of *Homo sapiens*, found in Jebel Irhoud, Morocco and dated to approximately 160,000 years ago. The novel application of high-resolution propagation phase contrast X-ray synchrotron microtomography, developed

by Paul Tafforeau during his PhD studies, permits previously inaccessible developmental features to be revealed non-destructively. Information on tooth growth in the Moroccan child was compared with other fossil and living human populations to determine if the modern condition of prolonged dental development was present. The results suggest that the Moroccan child, at almost 8 years of age, is currently the oldest member of the genus *Homo* to show a modern human life history profile. The team suggests that an extended period of development, and by implication childhood, may be linked to the origins of social, biological and cultural changes needed to support dependent children with greater opportunities for early childhood learning.

[TS / MF]

Original work:

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