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Testing growth models in euconodonts (Vertebrata): high-resolution imaging

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Conodonts are the first vertebrates to have developed mineralised, enamel-like tissues of unparalleled hardness. These tissues resemble vertebrate tooth enamel structurally and in terms of functional adaptations, but are unique in that they are able to repair both fractures and surface scores that occur during regular function. Euconodonts, the most derived group of conodonts, grew in a series of concentric layers deposited on the outer surface of the dental element. This allowed the elements to grow throughout the life of the animal. New techniques allow high resolution imaging of conodont lamellar tissues and reconstruction of growth dynamics, including episodes of in vivo repair. These are used to infer this animal's reaction to breakage of its teeth, and the steps taken to restore normal morphology. The reconstruction of conodont growth dynamics has been impeded by the difficulties in resolving individual growth layers (1 to 5 μm thick) in histological thin sections and on the surface of their elements. We propose a different approach based on SEM imaging, which reveals the individual episodes of growth. We apply this approach to pathological specimens to visualize the mechanism of repair. Pathological growth and malformations combined with high resolution images of lamellar tissues can provide an insight into the mechanism of biomineralisation of these teeth and reveal new histological features that have previously been unknown. A selection of abnormally developed conodonts from the Silurian of Sweden are examined and confronted with elements with normal growth to shed new light on this unique invention in the history of biomineralisation.