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Shedding light into the function of the earliest vertebrate skeleton

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Conodonts are an extinct group of jawless vertebrates, the first in our evolutionary lineage to develop a biomineralized skeleton. As such, the conodont skeleton is of great significance because of the insights it provides concerning the biology and function of the primitive vertebrate skeleton. Conodont function has been debated for a century and a half on the basis of its paleocological importance in the Palaezoic ecosystems. However, due to the lack of extanct close representatives and the small size of the conodont element (under a milimiter in length) strongly limited their functional analysis, traditional restricted to analogy. More recently, qualitative approaches have been developed, facilitating tests of element function based on occlusal performance and analysis of microwear and microstructure. In this work we extend these approaches using novel quantitative experimental methods including Synchrotron Radiation X-ray Tomographic Microscopy or Finite Element Analysis to test hypotheses of conodont function.

The development of high resolution virtual models of conodont elements, together with biomechanical approaches using Finite Element analysis, informed by occlusal and microwear analyses, provided conclusive support to test hypothesis of structural adaptation within the crown tissue microstructure, showing a close topological co-variation patterns of compressive and tensile stress distribution with different crystallite orientation. In addition, our computational analyses strongly support a tooth-like function for many conodont species. Above all, our study establishes a framework (experimental approach) in which the functional ecology of conodonts can be read from their rich taxonomy and phylogeny, representing an important attempt to understand the role of this abundant and diverse clade in the Phanerozoic marine ecosystems.