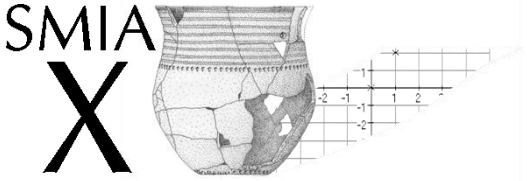
Paper



Bone and Teeth Microstructure: Searching for New Ways to Better Understand Functions in Fossils

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Abstract

Bones and teeth are hierarchically organized structures, that include adaptations to function at various length scales. To date, much of the information used to understand fossil bones and teeth are obtained at the macroscopic morphological level, or the microscopic level visible in optical microscopes. For example the orientations of bone trabeculae in relation to the applied loads. Much more microstructural information on function may be embedded in the length scales around tens of microns; the size range of the cells that produce these tissues. In a 3D study of the collagen organization of lamellar bone using the dual beam microscope and serial surface view, we have identified the presence of a disordered and less mineralized sub-structure within individual lamella. Furthermore one set of canaliculi are in close proximity to this layer. This structure may therefore play a crucial role in lamellar bone function. This structure may vary in size and organization between bones and/or between species in a way that reflects the bone function; a role that could also be explored in fossil bones.

We used high resolution microCT to map the pathway of a rat 1st molar tooth in the mandible as it is loaded . We show that contact occurs between the tooth root and the alveolar bone of the jaw at very specific locations. These locations contribute to the manner in which the tooth moves in response to load. MicroCT can be used to reconstruct the 3D morphologies of tooth and socket in fossil jaws and computer simulation of the docking of the tooth in the fossil jaw could in theory provide information on such contact points, and hence the built-in strategy for the tooth to resist loads without failing. Further questions arise as to whether these contact points have specialized structures that might also be detectable in fossils and help in the reconstruction of missing data. In conclusion, we propose that detailed structure-function studies of modern bones and teeth at the microstructural level, could open up new avenues of research of fossil bones and teeth.

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