Laboratory and Synchrotron MicroComputed Tomography of the 3D Hierarchy of Structures in Shark Vertebrae

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Shark vertebrae are high performance structures able to survive millions of cycles of high amplitude strain. These tissues consist of mineralized cartilage, and there are significant structural differences between vertebrae of species from different phylogenic orders. Microstructure has remained largely uninvestigated, and this study's purpose is to begin the process of quantifying the millimeter to micrometer sized structures in shark vertebrae. The approach is 3D x-ray imaging using lab microCT of entire vertebrae and synchrotron microCT of millimeter-sized blocks cut from vertebrae. Vertebrae of three species from Order Carcharhiniformes and three from Lamniformes are compared. Descriptions of vertebrae of the two orders are, with rare exception, limited and qualitative. Numerical, intra- and inter-order comparisons between vertebrae are presented and related to functional requirements for these organs.