Scanning Texture Analysis of Lamellar Bone using Microbeam Synchrotron Radiation

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Bone consists of mineral particle reinforced collagen and is structurally optimized for its biological functions. The 3D mineral nanostructure is still not fully understood. Specifically, little is known about the lamellar and sublamellar structure of the osteon, the fundamental unit of compact bone. The combination of microbeam (one micrometer) synchrotron scanning SAXS (small angle x-ray scattering) and WAXD (wide angle x-ray diffraction) allows us to reconstruct the full 3D mineral particle distribution at different positions within single osteonal lamellae. The WAXD data was used to calculate pole figures (stereographic projections), which delivers information on the mean orientation and texture of the principal axes of the mineral crystallites (which have a hexagonal cubic structure).

We scanned several osteons from a human femoral midshaft which were cut into slices of 3 micrometers. Our results show that the mineral crystal orientation has a fibre texture within single lamellae and shows intralamellar variation. The direction of mineral crystals rotates within the plane of each lamella.

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