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Mechanical Loading Patterns Determine Collagen and Mineral Orientation.
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Functional loading of the artiodactyl calcaneus produces relatively simple cranial-caudal bending. The relationship between this strain distribution and elastic anisotropy of bone (demineralized, decollagenized, and untreated) was investigated using an acoustic microscope. Seven mule deer calcanei were cut to remove the central third of the shaft. Three cross-sectional and three longitudinal 400μm thick sections were cut from the cranial ("compression"), caudal ("tension"), and medial and lateral ("shear") cortices. One section was demineralized (demin.) in 10% EDTA, one decollagenized (decol.) in 7% NaOCl, and one untreated. Acoustic velocity (AV) was measured for each section using an acoustic microscope. From AV measurements, an elastic anisotropy ratio (AR) was calculated (square longitudinal velocity/ square transverse velocity) [Table: means]. In the caudal and medial cortices all ARs significantly differed from 1.0 (isotropy). In the cranial and lateral cortices, only the untreated and decol. sections significantly differed from isotropy. High ARs of the caudal ("tension") cortex may reflect the sensitivity of the biplanar sections in detecting longitudinal orientations. Additional sectioning planes are necessary to identify oblique preferred orientations that may occur in compression and shear regions. These results are consistent with previous reports of regional matrix anisotropy quantified with circularly polarized light.

	Cranial	Caudal	Medial	Lateral
Untreated	1.34	1.55	1.25	1.30
Demin.	1.13	1.22	1.10	1.13
Decol.	1.54	2.03	1.49	1.47