A67 The Occurrence of Osteon Banding in Adult Human Cortical Bone

Janna M. Andronowski, PhD, University of Akron, Dept of Biology, Auburn Science and Engineering Complex, Akron, OH 44325-3908; Isaac V. Pratt, MSc, University of Saskatchewan, 107 Wiggins Road, Saskatoon, SK S7N 5C5, CANADA; and David M.L. Cooper, PhD, University of Saskatchewan, Dept of Anatomy and Cell Biology, 107 Wiggins Road, Saskatoon, SK S7N 5E5, CANADA*

After attending this presentation, attendees will have an appreciation for the occurrence of osteon banding in adult human cortical bone.

This presentation will impact the forensic science community by providing key data supporting the presence of multiple osteon bands in single specimens, indicating that this phenomenon should not categorically be taken as evidence of non-human bone. This will result in a higher quality of forensic practice since human species origin should not be ruled out when a significant pattern of osteon banding is encountered in primary and/or secondary lamellar bone.

Differentiating human from non-human fragmented bone is often accomplished using histological methods if the observation of gross morphology proves insufficient. Linearly oriented primary and/or secondary osteonal systems, commonly referred to as osteon bands, are described in the literature as a strong indicator of non-human bone. This phenomenon has been conventionally documented using two-dimensional histology, but such analyses are destructive and typically limited to a single cross-section; however, progressive developments in high-resolution X-ray imaging allow for the non-destructive 3D visualization of bone microarchitecture.

In a previous survey of osteocyte lacunar variation in adult human skeletal elements using Synchrotron Radiation-based micro-Computed Tomography (SR micro-CT), the presence of osteon banding in cortical bone in various bone types was frequently observed.[1] As such, the primary objective of the current research was to visualize and document the occurrence of osteon banding in adult human cortical bone using high-resolution SR micro-CT.

SR micro-CT scanning was conducted at the Canadian Light Source national synchrotron facility. The presence or absence of osteon banding was visualized in human skeletal elements from three adult males with representative samples from all regions of the skeleton (n=129). Visualization of osteon boundaries were enhanced by applying z-projections through 90μm (100 adjacent slices at 0.9μm thickness) and by observation of osteocyte lacunar patterns. Additional projections (standard deviation and minimum intensity) were employed to enhance visualization of air-filled vascular spaces and high-density bone tissue. Subsequently, 3D renders of bone microarchitecture were created. All projections in each image stack were assessed for the presence of osteon banding. An osteon band was defined as a discrete row of five or more primary and/or secondary osteons, as described by Mulhern and Ubelaker.[2] The number of bands in each specimen and the number of osteons per band were documented.

Results indicated that 23 of 129 human cortical bone specimens exhibited osteon banding, representing 18% of the sample. Linear arrangements of primary and/or secondary osteons were observed in the following skeletal elements: temporal, parietal, frontal, occipital, clavicle, mandible, femur, tibia, ulna, second metatarsal, and sacrum. Multiple osteon bands were observed in the temporal, parietal, occipital, and mandible specimens, with three being the maximum number of bands observed. In these elements, osteon bands ranged from 5 to 12 osteons in length and were comprised mainly of primary osteons.

Per research, this work represents the first report of: (1) multiple osteon bands within a single adult human cortical bone specimen; and, (2) inter-element variation in osteon banding from cortical bone from various modern adult human skeletal elements. The frequent occurrence of osteon banding, and the presence of multiple osteon bands within a single specimen, indicate that this histomorphological feature is not solely diagnostic of non-human bone. This characteristic should not be used as a distinguishing feature if alternative non-human characteristics are clearly less visible. Overall, the analyst should not rule out a human species origin when a more significant pattern of osteon banding is encountered in primary and/or secondary lamellar bone.

Reference(s):

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2. Mulhern, D.M., Ubelaker, D.H. (2001). Differences in Osteon Banding Between Human and Nonhuman Bone. *J Forensic Sci*. 46(2), 220–222.

Cortical Bone, Osteon Banding, Micro-CT

*Presenting Author