

Current Exclusion Criteria for Selecting Osteons for Circularity Analysis Are Potentially Problematic

JOHN G. SKEDROS, KENDRA E. KEENAN, SCOTT M. LITTON, GREGORY A. SKEDROS, CHAD S. MEARS¹,

¹ Dept. of Orthopaedics, Univ. of Utah School of Medicine, Salt Lake City, Utah

Variations in secondary osteon (SO) cross-sectional shapes are useful for determining species affiliations and interpreting load history. SO cross-sectional shape is expressed as “circularity index” [$CI = 4\pi(\text{area}/\text{perimeter}^2)$; 1.0=perfect circle]. Recent studies recommend that SOs used in CI analysis should be selected based on central canal shape: (1) Crescimanno and Stout (“C&S”2012, J. Forensic Anthro.) selected osteons with central canals >0.9 CI; (2) Dominguez and Crowder (“D&C”2012, AJPA) selected osteons with central canals not exceeding 2:1 ratio of the max:min diameter. We hypothesized that the selection biases of these exclusion criteria eliminate important biological information. Using ImageJ we examined backscattered electron images (BSEi; 2 micron/depth) and circularly polarized light images (CPLi; 100 micron/depth) from modern human femoral shafts (n=12, avg. 53years;25-71;male:female=3:9) and adult deer calcanei (representing a broad range of osteon sizes/shapes): (1) humans: 400 osteons/BSE, 1784 osteons/CPL; (2) deer: 1328 osteons/BSE; 177 osteons/CPL). C&S criteria excluded: (1) deer 307(23%) osteons from BSEi, and 125(70%) osteons from CPLi; (2) human 80(20%) osteons from BSEi, and 680(38%) osteons from CPLi. D&C criteria excluded: (1) deer 116(9%) osteons from BSEi, and 79(45%) osteons from CPLi; and (2) human 45(11%) osteons from BSEi, and 232(13%) osteons from CPLi. Although both the C&S and D&C exclusion criteria reduced sample sizes, statistical analyses were still possible. However, the significant CI difference between dorsal “compression” and plantar “tension” aspects of the calcaneus shown when using all OS became non-significant using the samples remaining after the exclusions. Therefore, these exclusion criteria forced an errant interpretation of load history.