

# Characterization of the Spatial Arrangement of Secondary Osteons in the Diaphysis of Equine and Canine Long Bones

## *Abstract*

The blood supply of bone cells in compact bone is provided primarily by blood vessels located within Haversian canals forming the centre of osteons. Mid-diaphysial cross-sections of radii and third metacarpal bones from two horses and radii from two mature dogs were studied using reflective light microscopy to quantify the spatial ordering of canals and compared to a computational model. The distributions of canals were analyzed using: 1) the autocorrelation function (ACF), which describes the probability of finding two canals separated by a given distance and 2) the shortest distance distribution (SDD), which describes the probability that a site within bone is located at a given distance from the nearest canal. The order in the investigated horse radii, as characterized by the oscillations of the ACF, was found to be independent of the anatomical location although, in the metacarpal bone the order was higher in the lateral than in the cranial location. Among the dogs, marked differences were only found in the ACF. An analysis of the SDD demonstrates that ordering of canals minimizes the distance of osteocytes from a blood vessel. This suggests that the efficiency of the blood supply can be adapted through differences in the order of the Haversian canals. In our model, the ordering of canals is achieved via an exclusion zone around each canal, imposed upon newly formed osteons. Simulations demonstrate that differences in the observed order can be explained by either a larger size or a larger variability of this exclusion zone.

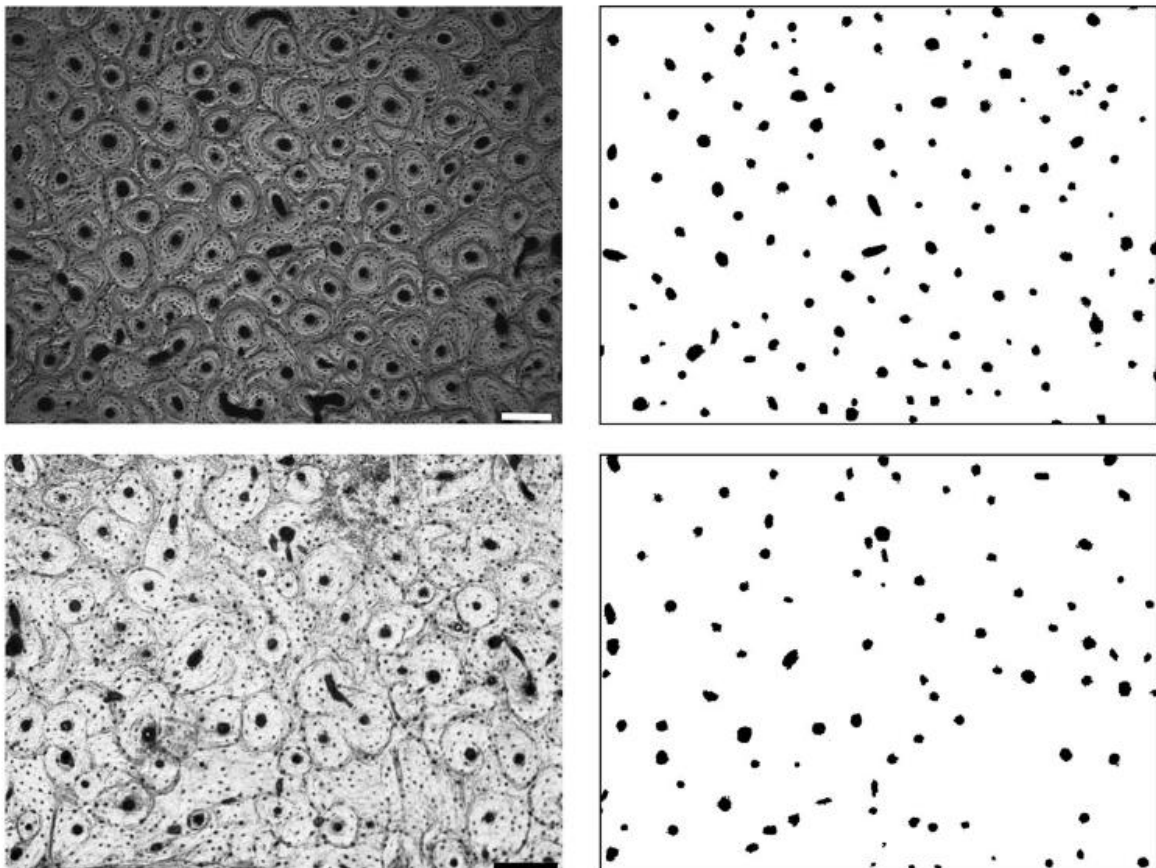


Fig. 1. Left: Polished cross-sections of the cortical bone of equine radius lateral position (top), and of canine radius caudal position (bottom) using reflective light microscopy. The scale bars denote 250  $\mu\text{m}$  for the horse bone, and 200  $\mu\text{m}$  for the dog bone. On the right, the corresponding cleaned images showing only the Haversian canals in black.