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Increased frequency of capillaries at remodelling sites in adult human bone

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Formål	Osteogenesis depends critically on vascularisation in bone development and fracture healing. It is unknown whether such a relation exists between vascularisation and remodelling in cancellous bone. Here, we investigate how capillaries and a putative osteoblast progenitor marker, smooth muscle actin (SMA) distribute above eroded (ES), osteoid (OS) and quiescent surfaces (QS) and relate to the presence of the bone remodelling compartment (BRC) canopy.
Metode	The study includes nine paraffin embedded iliac crest biopsies from control patients. Adjacent sections were stained so that information from histomorphometry and immunohistochemistry could be combined. The distance from the bone or canopy to the CD34 class II stained capillary was measured on an orthogonal line up to 100 µm into the bone marrow. For SMA only the distribution on the surface or in the canopy was recorded. The electron microscopy (EM) was performed on three EPON embedded biopsies from patients with primary hyperparathyroidism.
Resultater	The zone spanning 100 µm above ES, and OS, compared to that above QS, show respectively a 1.79 and 1.3 times higher capillary density in the absence of the BRC canopy, and a 2.55 and 1.8 higher level in its presence. Moreover light microscope-assessed capillary-canopy contacts are as much as 3.39 and 2.35 times higher above respectively ES and OS, compared to capillary-QS contacts. Densities above remodelling sites decrease progressively with increased distance from the bone surface, and at a 50 µm distance, they equal the level above QS. EM shows that the capillaries line the BRC canopy at less than 1 µm distance between the two membranes, and that cells perform diapedesis through the capillary wall and the BRC canopy. The density of SMA in the BRC canopy is 2.56 times higher above ES compared to QS, and on the bone surface the density is 1.47 times higher on ES, compared to OS. Furthermore, when SMA is not expressed in the canopy it is very rarely expressed on the bone surface below the canopy. All the reported differences are highly statistically significant.
Konklusion	These data support that capillaries are an important component of the mechanism controlling adult human cancellous bone remodelling. The higher levels of capillaries above ES compared to OS suggest that capillaries are present from the beginning of the remodelling process, thereby participating in recruitment of osteoclast and osteoblast progenitors as suggested by our observations of diapedesis and SMA distribution.