# DIFFERENCES BETWEEN SUBCHONDRAL AND TRABECULAR BONE MICROPOROSITIES BENEATH THE BONE-CARTILAGE INTERFACE AT THE KNEE JOINT

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Articular joints are complex structures that rely on biomechanical and biological integration of two strongly dissimilar tissues: the hard mineralized bone and the soft cartilage. Where bone and cartilage are joined together, both tissues present specific adaptation strategies to solve their dissimilarities. The bone beneath articular cartilage is very heterogeneous, with a subchondral region, a thin growth plate and then the trabecular compartment which fades into the medullary cavity. Given the unique ability of bone to reorganize its structure according to the local mechanical environment, we investigate whether bone below articular cartilage in the knee displays specific microstructural features to facilitate force transmission from the knee joint to the cortical shell. Specifically, we used X-Ray micro-computed tomography (micro-CT, 15 µm isotropic voxel size) to characterize the spatial evolution of bone microstructure when approaching the articular cartilage in adult male Sprague-Dawley rats (animal study approved by the Animal Ethics Committee of the University of Liège, ULg IACUC-22-2416). Our quantification of the overall bone morphology revealed that proximal trabecular bone regions (which probably included both primary and secondary trabeculae) below the growth plate had a bone volume fraction (BV/TV) about 20% higher than subchondral bone, mainly due to a decreased trabecular spacing (Fig. 1A), with only small changes in trabecular thickness. A central observation is the large difference in the degree of anisotropy (DA) between the two regions: the trabecular network beneath the growth plate was about 3.6 times more anisotropic than subchondral bone. A spatially resolved analysis was then performed, using moving cubes of 750 µm side length, placed in the antero-medial position (Fig. 1B). Moving away from the growth plate, BV/TV decreased in a double-liner fashion: firstly quite fast (slope of 45.16%/mm) then more gradually (28.57%/mm). This drop was accompanied by an increase in the anisotropy when approaching the medullary cavity. Our results highlighted distinct microstructural features in locations right above and below the growth plate, probably reflecting fairly dissimilar loading conditions despite being very adjacent regions. Ongoing work focuses on characterizing microporosity at a higher resolution to quantify the shape and arrangements of osteocytes and chondrocytes lacunae in bone and mineralized articular cartilage, comparing healthy and aged bone.

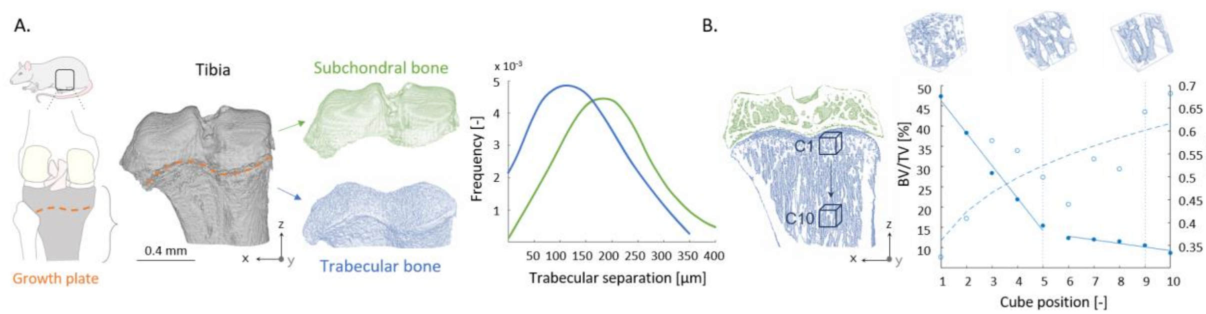


Fig.1: A. Sketch of the investigated bone regions and frequency distribution of trabecular separation in subchondral (green) and trabecular (blue) bone. B. Spatial resolved analysis and evolution of bone volume fraction (BV/TV, full line and filled dots) and degree of anisotropy (dashed line and empty dots).