**Assessing Photon Counting CT Reproducibility And Least-Detectable Bone Remodeling**

For the quantification of local bone strength and bone changes, quantitative CT is to be preferred over conventional techniques such as DXA. However, the low resolution of conventional clinical CT limits direct implementation in health care. Photon Counting CT (PCCT) shows potential to overcome this limitation thanks to its higher resolution and image contrast. This study investigates the reproducibility of PCCT and the least-detectable change in bone mineral density, discernable from noise.

Using PPCT (NAEOTOM Alpha, Siemens Healthineers), eighth cadaveric wrists have been scanned twice with repositioning. For each wrist, the eight carpal bones were delineated. Images have been registered onto each other and the difference image was calculated by voxel-wise subtraction. In parallel, a phantom was scanned and a linear relation was fitted, expressing bone mineral density in function of Hounsfield unit. Local remodeling was detected when the difference image surpassed a predefined threshold. In an additional filtering step, only remodeling clusters larger than 5 voxels were selected.

Figure 1 shows the mean formation and resorption expressed in percentage of bone volume in function of different thresholds. For a threshold of 250 mgHA/cm³, the total amount of falsely detected remodeling amounts to 0.31% (formation 0.14% +- 0.17%; resorption 0.17% +- 0.39%). This is below an acceptable noise level.

In a similar study with HR-pQCT, Christen et al. [1] reported 0.4% remodeling for a threshold of 225 mgHA/cm³ in an *ex vivo* analysis. Using this threshold, the *in vivo* remodeling increased to >5%. These results show high comparability with HR-pQCT. No data is available to compare the *in vivo* case, although it can be expected that the difference for PCCT will be less pronounced. This because of the shorter acquisition time which limits motion artifacts.

PCCT shows an excellent reproducibility when used for the quantification of local bone mineral density and results are comparable to HR-pQCT. This study considers bone remodeling based on image intensity exclusively, however, also voxel size plays an important role, which could favor HR-pQCT. We will 1) repeat the analysis for the *ex vivo* samples and 2) use PCCT for an *in vivo* follow-up study in patients.

[1] P. Christen et al., “Least-detectable and age-related local in vivo bone remodelling assessed by time-lapse HR-pQCT,” *PLoS One*, vol. 13, no. 1, p. e0191369, Jan. 2018.