Automated i*n Vivo* Quantification of Human Cortical Bone Thickness and Porosity by HR-pQCT

Kyle Nishiyama[1,2], HR Buie[1,2], HM Macdonald[1,2], DA Hanley[3], SK Boyd[1,2]
[1]*Department of Mechanical and Manufacturing Engineering - University of Calgary, Calgary*
[2]*Roger Jackson Centre for Health and Wellness Research - University of Calgary*
[3]*Division of Endocrinology and Metabolism, Department of Medicine - University of Calgary*

Aging has been shown to cause many changes in the structural properties of bone such as reduced cortical thickness (Ct.Th) and increased cortical porosity (Ct.Po) which may increase the risk of fracture. The purpose of this study was to establish the ability of high resolution peripheral quantitative computed tomography (HR-pQCT) to quantify Ct.Th and Ct.Po *in vivo* through fully automated analysis by validating it against the gold standard, micro-computed tomography (μCT). Automated image registration and cortical segmentation (Bone, 2007 41:505-15) procedures were used to obtain direct measurements of Ct.Th and Ct.Po from 8 human cadaver forearms (5 women, 3 men, ages 68-93 years, mean 84) that were scanned at the standard measurement site using HR-pQCT (XtremeCT, Scanco Medical, Switzerland), followed by scanning and analysis of the dissected radii by μCT (vivaCT 40, Scanco Medical, Switzerland). The nominal isotropic resolution for the HR-pQCT and μCT were 82μm and 19μm, respectively. A linear regression analysis was performed relating the HR-pQCT measurements to the μCT measurements giving R^2 values of 0.97 for Ct.Th and 0.60 for Ct.Po. To demonstrate the method on a large scale, the analysis was then applied to distal radius HR-pQCT scans from a sample (339 women, 171 men, ages 20-99 years) of the Canadian Multicentre Osteoporosis Study (CaMos). In summary, this automated method provides a tool to measure Ct.Th and Ct.Po *in vivo* using HR-pQCT, and has been applied to a large cohort to identify changes in Ct.Th and Ct.Po.