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Cross-calibration of BMD measurement between a dedicated pQCT scanner and QCT of peripheral sites using a clinical whole-body helical CT scanner

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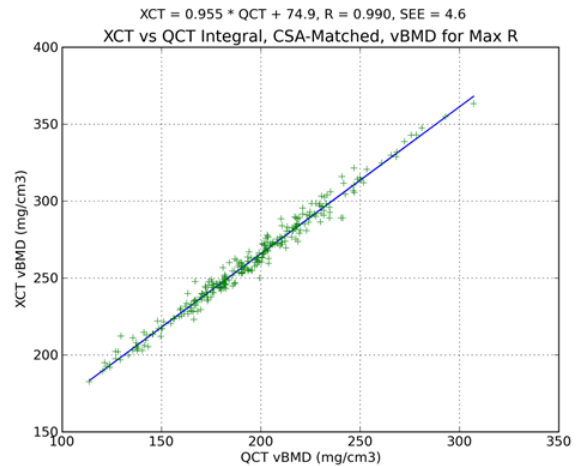
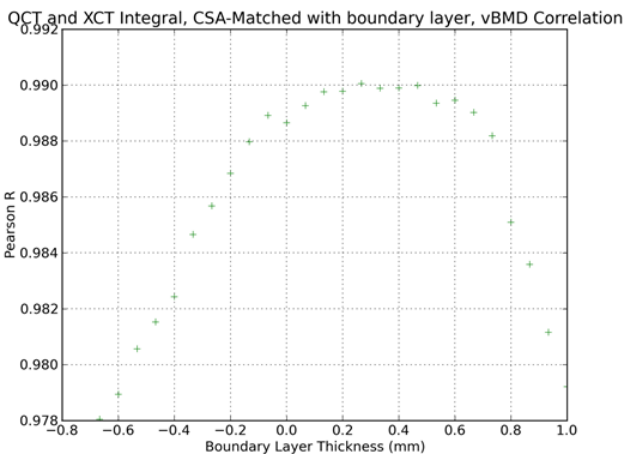
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Introduction: Dedicated pQCT scanners have restricted availability, require minutes of scanning time often causing motion artifact, and image isolated slices. Whole-body helical CT scanners are widely available and require only seconds per scan. A previous study has explored the use of whole-body scanners for pQCT [1] but the provision of pediatric normal data has not been addressed.

Method: Our 287 M & F subjects (14.4 ± 2.7 years; range 8-23) cohort had tibia CT imaging with QCT calibration (Mindways, Austin, TX) and pQCT using Stratec XCT2000 (Orthometrix, White Plains, NY) on one day. Whole tibia CT was 120 kVp, 1 mm slices and 0.5 mm pixels; 2.3mm pQCT slices were at 3% proximal to the distal physis, 0.4 mm voxels. Volumetric integral BMD (vBMD) was compared by matching bone cross-sectional area (CSA) of XCT scans with QCT slices correcting for resolution difference. Cross-calibration was by linear least-squares.

Results: The effective "boundary layer" for maximum correlation when comparing CSAs from the two methods was ~ 0.4 mm (see graph). Using this thickness, a linear correlation for vBMD was found with $R=0.990$ and a standard error (SEE) of 4.6 mg/cm^3 . A linear cross-calibration equation for vBMD was determined as $\text{XCT} = 0.96 * \text{QCT} + 75 \text{ mg/cm}^3$.



Conclusions: A strong correlation in vBMD estimates was observed with a an offset of $\sim 75 \text{ mg/cm}^3$ consistent with Stratec machines using fat as the zero for BMD while Mindways uses water. The SEE of 4.6 mg/cm^3 is much less than expected normal-population vBMD dispersion estimates. The observed cross-calibration equation could be used to convert whole-body CT derived vBMD estimates for comparison to existing Stratec reference data.

[1] Engelke et al. *Bone* 45(1):110-8, 2009