quantifiably better.

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

Bodeen G[1], Mahboubi S[2], Brown JK[1], Zemel BS[2], Brett AD[1], Leonard MB[2]

[1]Mindways Software Inc, Austin, TX, USA

[2]Children's Hospital of Philadelphia, Philadelphia, PA, USA

Introduction & Objectives

Cross-calibration of whole-body CT to pQCT was examined to address practical challenges in pQCT.

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.

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

Methods

Subjects were scanned using whole-body and dedicated pQCT methods.

Our 287 male and female subjects (14.4 ± 2.7 years; range 8-23) cohort had tibia CT imaging with QCT calibration (Mindways, Austin, TX) and on the same day pQCT using Stratec XCT2000 (Orthometrix, White Plains, NY). The whole tibia CT protocol was set at 120 kVp, 1 mm slices and 0.5 mm pixels; the pQCT slices were 2.3 mm thick, using 0.4 mm voxels, and were located at 3% of the distance from the proximal to the distal physis. Volumetric integral BMD (vBMD) was compared after matching each subject's XCT scan to their QCT image slice having the same cross-sectional area (CSA), and further correcting for resolution difference. Cross-calibration was calculated using linear least-squares.

Results

Cross-calibration equations were determined using the boundary layer thickness that maximized correlation.

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 XCT = 0.96 * QCT + 75 mg/cm^3.

Conclusion

Strongly correlated vBMD estimates permit development of cross-calibration equations

A strong correlation in vBMD estimates was observed with an offset of ~75 mg/cm^3, which is consistent with the difference in choice of zero for the BMD scale; Stratec machines use fat as the zero while Mindways uses water. The SEE of 4.6 mg/cm^3 is much less than the expected normal-population vBMD dispersion estimates. The cross-calibration equation determined from the observations could be used to convert whole-body CT-derived vBMD estimates for comparison to existing Stratec reference data.