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A New Clinical Approach to Quantitative CT (QCT) Bone Densitometry with Asynchronous Calibration

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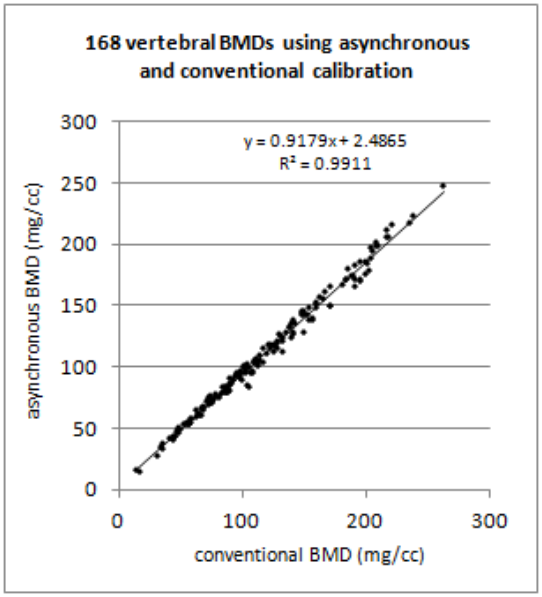
Objective(s): Asynchronous calibration for quantitative CT (QCT) bone densitometry permits extracting QCT measurements from other abdominal/pelvic CT procedures with zero additional radiation dose. Accuracy and precision in CT bone densitometry have previously relied on simultaneous scanning of a calibration phantom with the patient. We report here assessments of systematic and random measurement differences between a prototype commercial QCT device using asynchronous calibration and a commercially available conventional QCT device.

Material and Methods: Our retrospective cohort included 168 vertebrae from 78 subjects and 146 femoral scans from 73 subjects, ages ranged 3 to 97; the scans were from multiple scanner models from each of four major manufacturers. BMD for each vertebra or femur was measured in QCT PRO Version 5.0 (Mindways Software, Austin, TX, USA) in its conventional mode and a new mode for asynchronous calibration using independently acquired, scanner-specific QA scans.

Results: Vertebral BMD ranged from 13.4 mg/cc to 262.2 mg/cc. The linear least-squares regression line between calibration conditions lay slightly off unity, showing a consistent bias wherein asynchronously calibrated BMD averaged 5.4% lower than conventional BMD. The SEE of this regression was 5.0 mg/cc.



Results were similar in the proximal femur, with a correlation above 0.98, an average decrease of 5.8% versus conventional BMD, and a SEE of 0.021 g/cm2 for data ranging from 0.335 to 1.254 g/cm2. In addition, we assessed correlations of the BMD measurement bias to CT manufacturer, X-ray energy, and patient size. These revealed no statistically significant trends.

Conclusion(s): The high correlations of asynchronously calibrated BMD with conventional BMD suggest this approach has substantially equivalent accuracy in reproducing T-Scores. A linear transformation suffices to correct the measurement bias (possibly caused by differences in beam hardening) without introducing significant variance. This approach may provide new clinical utility in dual-use and retrospective CT BMD screening.