cortical bone density in CT-based models of bone strength.

The consistency in the CV for the calibrated density of each standard indicates the hydroxyapatite is reasonably consistent throughout the volume and, therefore, there is no need to standardize the ROI location between one scan and another. As expected, the 100 mg/cm^3 standard has the greatest CV given that the standard deviation of the measure is normalized by the mean. Our results compare favorably with previously reported CV of 0.4 to 2.5% (Braillon 2002, Kalendar and Suess 1987, Steiger *et al.* 1990).

It should also be noted that, for the purposes of this study, the calibration was based solely on homogeneous standards with mineral densities within the range of trabecular and cortical bone tissue. Since the calibration was not based on a water equivalent standard, the calibration equations determined in this study do not have an intercept of zero, nor was the intercept forced to be zero. Therefore, this calibration is not suitable for studies focused on the quantification of specific soft tissue types or composition of soft tissues.

Our study is not without limitations. Calibration will be affected by the position of the standards in the field of view and each center will need to confirm the applicability of these results to the specific experimental set up. Schileo *et al.* (2008) however, found a comparable calibration equation (calibrated density = 0.7764 HU - 5.6148 in mg/cm^3) using Brightspeed, CT scanner (GE Medical Systems, helical mode, slice spacing and reconstruction of 0.625 mm, 120 kV, 160 mAs, pixel dimensions 0.3125 × 0.3125 mm^2) and three certified hydroxyapatite solution inserts of 50, 100 and 200 mg/cm^3 (European Spine Phantom) in water. It should also be noted that beam hardening corrections are scanner specific. The effect of the basic beam hardening correction algorithm included in all scan protocols acquired using our GE helical multi-slice CT scanner is observed in Fig. 2. The air condition represents the absence of beam hardening since there is no additional material in the path of the beam apart from the calibration standard. No further bone algorithm was used in our study. These results can not be generalized to protocols where other correction algorithms and/or CT scanners from other manufacturers are used.

Our study shows that conversion of HU to mineral density is highly repeatable for scans performed using identical imaging parameters and a General Electric Lightspeed Plus helical multi-slice CT scanner. To relate ex vivo CT data to in vivo conditions, it is important to scan a specimen and calibration standard in a soft tissue volume or in water, which most closely resembles the X-ray attenuation characteristics of soft tissue in the anatomical region of interest.

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