Presented at ASBMR Meeting 2013

Comparison of DXA and Quantitative CT Bone Mineral Density Measurement using Contrast Enhanced Scans at the Proximal Femur: Implications for Opportunistic Osteoporosis Screening

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Introduction: For patients undergoing routine contrast-enhanced MDCT examinations, an opportunity exists for concurrent osteoporosis screening without additional radiation exposure or patient time using proximal femur quantitative CT (QCT) "CTXA". Previous studies demonstrated equivalence between unenhanced CT and DXA for femoral neck BMD evaluation; and have suggested a small BMD bias correction for enhanced CT studies. We investigated the effect of IV contrast enhancement on femoral neck CTXA T-score measurement compared with DXA.

Method: This cohort included 78 male and 277 female adults (mean age, 59.7±13.3 years; range, 21-90 years) who underwent standard contrast-enhanced CT assessment including the pelvis at $120kV_p$ (GE Healthcare, Waukesha, WI) between November 2001 and December 2009. All subjects also had DXA BMD (GE Lunar, Madison, WI) assessment within 100 days of the CT study (mean 46±30 days). DXA T-scores were calculated using the NHANES III female reference data. Areal BMD in g/cm^2 of the femoral neck was measured on the CT series using QCT Pro Version 5.1 (Mindways Software, Austin, TX) with asynchronous phantom calibration. QCT T-scores were derived using manufacturer's female reference data.

Results: Linear regression analysis showed good correlation between DXA and CTXA (R2 = 0.824 for both BMD and T-scores) and the SD of the distribution of residuals (SEE) was 0.063 g/cm^2 or 0.45 T-score units. A Bland-Altman plot of T-scores indicates no trend in differences between the two measurements and a small bias with DXA T-score +0.18 units higher than CTXA.

Conclusion: In this cohort, femoral neck T-scores obtained by CTXA and DXA are highly correlated. The SEE for BMD correlation compares favorably to that of a prior study comparing DXA and CTXA (0.053 g/cm^2) and may be higher due to variance in bias introduced by contrast enhancement in this study. The small bias between DXA and CTXA T-scores presented here may be due to differences in CT scanner calibration due to differences in CT table scan height and scanner type. In conclusion, for opportunistic osteoporosis screening at routine post-contrast abdominopelvic CT scans, CTXA produces T-scores similar to DXA. Femoral neck QCT BMD measurement is now included in the WHO FRAX® tool and this method could greatly enhance osteoporosis screening since it can be applied regardless of the clinical indication for CT scanning.