quantifiably better.

Direct Comparison of Pre- and Post-Contrast Enhanced Scans for Quantitative CT Bone Mineral Density Measurement at the Proximal Femur: Implications for Opportunistic Osteoporosis Screening.

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Introduction

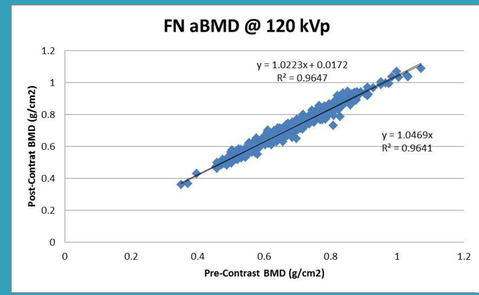
Opportunity exists for concurrent BMD screening without additional imaging

For patients undergoing routine contrast-enhanced MDCT examinations, an opportunity exists for concurrent BMD screening without additional radiation exposure or patient time using quantitative CT (QCT) of the proximal femur. Previous studies have demonstrated equivalence between unenhanced CT and DXA for femoral neck BMD evaluation, but the impact of IV contrast requires further study. We investigated the effect of IV contrast enhancement on areal BMD measurement compared with the established DXA-equivalent pre-contrast QCT analysis ("CTXA") at the hip.

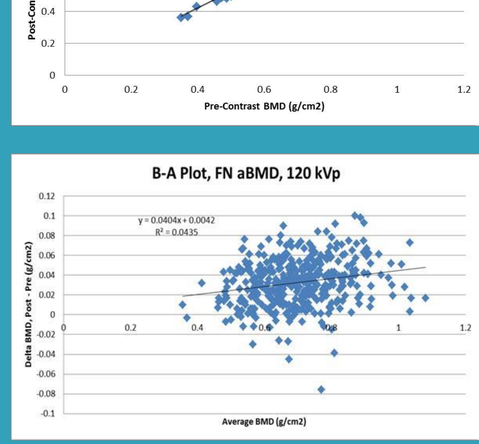
Methods

Patients underwent standard CT urography and pre- and post-contrast retrospective QCT

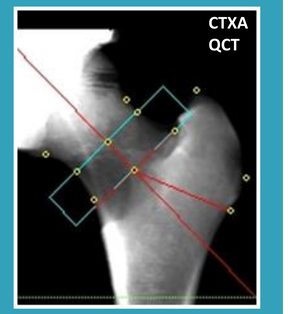
Our cohort included 410 male and female adults (mean age, 65.3±10.0 years; range, 49-95 years) who underwent standard CT urography (CTU) at 120kV$_p$ (GE Healthcare, Waukesha, WI) between August 2011 and May 2013. CTU exams represent an ideal protocol for this assessment as both pre-and post-contrast series are obtained, and the split-bolus contrast-injection technique effectively combines dynamic and delayed phases, resulting in excreted contrast within the urinary bladder. Areal BMD (aBMD) in g/cm^2 of the femoral neck was measured on both pre-and post-contrast CT Series using QCT Pro Version 5.1 (Mindways Software, Austin, TX) with asynchronous phantom calibration. Constant bias and multiplicative factor corrections for the post-contrast series were derived from the Bland-Altman plot linear regression slopes.



BMD measured by QCT on the pre-contrast and post-contrast series of 410 CTU patients



Bland-Altman plot for QCT BMD on pre-contrast and post-contrast series of 410 CTU patients.



Results

T-score categorization changed between pre- and post-contrast series in 15.4% of patients prior to correction

Mean pre- and post-contrast aBMD of the femoral neck was 0.68±0.12 and 0.71±0.12 g/cm^2, respectively. Although the estimated slope of a correction was significantly different from zero ($p<0.0001$), the SD of the distribution of residuals (SEE) for a constant bias and a multiplicative model correction were very similar at 0.0232 and 0.0231, respectively. The constant bias correction associated with contrast enhancement was 0.032±0.023 g/cm^2 which corresponds to 0.29±0.21 T-score units using the CTXA young normal aBMD reference SD of 0.111 g/cm^2. T-score categorization changed between pre- and post-contrast series in 63 (15.4%) of 410 patients prior to simple correction, compared with 35 (8.5%) patients after correction.

Conclusion

A simple offset correction could greatly enhance osteoporosis screening

For the purposes of opportunistic osteoporosis screening at routine post-contrast abdominopelvic CT scans, a simple offset correction of -0.3 T-score units for femoral neck BMD assessment appears to be appropriate. This simple additive measure could greatly enhance osteoporosis screening since it can be applied regardless of the clinical indication for CT scanning. Given the enormous patient volume of body CT scanning currently performed in older adults for a wide variety of clinical indications, this represents a unique opportunity to expand osteoporosis screening. Importantly, this opportunistic screening requires no additional patient time or radiation exposure, further enhancing the clinical yield of the scan.

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