INTRODUCTION

- Fracture risk increases independently of dual energy x-ray absorptiometry (DXA) t-scores calculated from areal bone mineral density (aBMD).\(^1\)

- Quantitative computed tomography (QCT) utilizes phantom calibration rods of known densities to quantify volumetric BMD (vBMD) which can provide a more thorough assessment of skeletal mineralization than DXA.\(^2\)

- However, potential variation in attenuating x-ray photons within QCT scans may influence the Hounsfield Units (HU) of phantom rods and resulting calibration curves which can misrepresented vBMD and differential fracture risk.

The objective of this study is to assess variation in vBMD when using a location-specific phantom calibration compared to a general scan-specific phantom calibration.

MATERIALS and METHODS

- n=50 male post-mortem human subjects (PMHS) with ages ranging from 24 to 89 years (61 ± 14) were scanned on clinical quality CT systems (0.6mm slice thickness, 120 kVp, variable reference mAs) with an INTable\(^\text{TM}\) phantom containing rods of known densities (0mg/cc to 150mg/cc).

- A validated custom MATLAB code was used to obtain HU values from each phantom rod (Fig.1) at the anatomical locations of L2, L3, L4, the left femoral neck (L-Fem-neck), and the left calcaneus (L-Calc).

- For each scan, location specific calibration curves (LS) were created from phantom rods at each volume of interest (VOI). A general scan specific calibration (Gen.) curve was created from L3 anatomical location. (Figs. 2 and 3)

- Osirix MD was used to manually collect mean HU from a VOI of 3 skeletal tissue types: trabecular (Tb) cortical (Ct), and Total (Tb and Ct) (Table 1).

- vBMD was then calculated for each VOI using the regression equations for both Gen. and LS calibration curves (Fig. 4).

- General Scan Specific Calibration

- Location Specific Calibration

RESULTS and DISCUSSION

- Table 1: Paired t-tests of vBMD from LS calibration curves and Gen. Calibration curves. Significant differences were found in all Fem-neck and Calc sites (p<0.01) but not in any lumbar site (p>0.01).

- These trends were exaggerated in the Tb VOIs for the Fem-neck with increased negative difference but decreased in the Calc which may be a result of differential linear x-ray attenuation across the PMHS.

CONCLUSIONS

- Utilizing a single scan-specific calibration curve to quantify vBMD may significantly alter assessments of differential fracture risk in other regions of the body.

- Variation in over/underestimation of vBMD when general scan specific calibration curve may differentially impact fracture risk thresholds and material properties of finite element models.

- Additional research is needed to understand how non-location specific calibration curves may influence vBMD elsewhere in the body and investigate the influence of age, sex, and body size on these results.

REFERENCES CITED


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