



# AREA- AND VOLUME-BASED QCT REFERENCE DATA FOR THE PROXIMAL FEMUR

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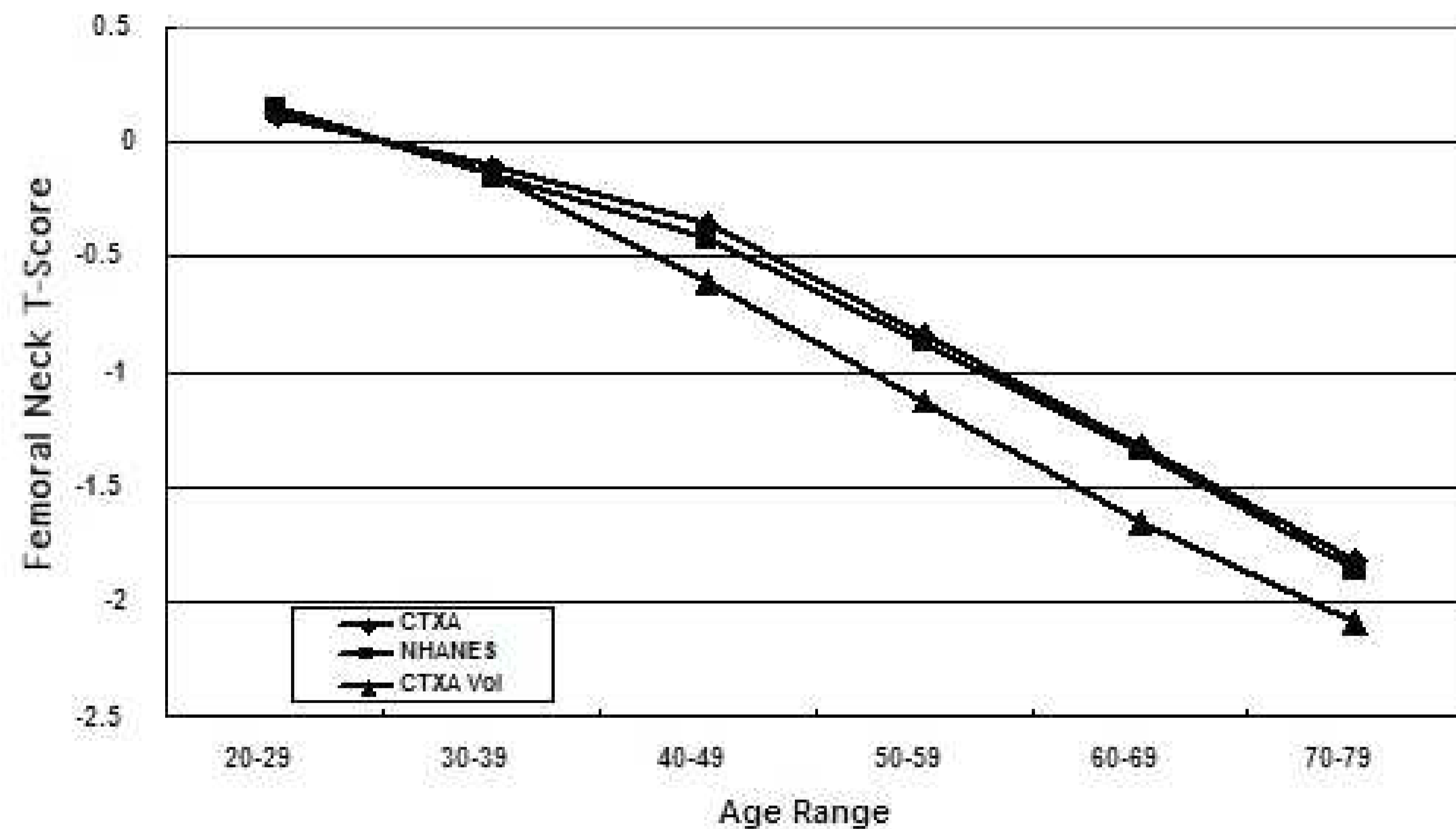
## Objectives

Bone mineral density (BMD) estimates for the proximal femur acquired with Dual Energy Absorptiometry (DXA) are considered the standard clinical method to diagnose osteoporosis in an individual patient on the basis of BMD alone. The World Health Organization (WHO) international reference standard for osteoporosis diagnosis is -2.5 or more standard deviations from peak bone density in a young normal population (-2.5 or lower T-score) at the femoral neck. Quantitative Computed Tomography (QCT) can produce DXA-equivalent "CTXA" areal BMD measurements at the proximal femur, but to calculate a T-Score according to the WHO standard, normal reference values are required for CTXA. We have developed a normal reference BMD database for US Caucasian women for use with the QCT CTXA Hip software (Mindways Software, Inc., Austin, TX), and we compared the resulting T-Scores to NHANES III DXA data.

## Results

There were no statistically significant differences between the BMD values as measured on different CT scanners and the known values at the 95% confidence level ( $p < 0.05$ ). We found no significant variation across centers, regions, or ages in Body Mass Index by ANOVA ( $\alpha = 0.05$ ). The young reference averages from the pooled data for ages 20-39 were  $0.922 \pm 0.116 \text{ g/cm}^2$  for

the Total Hip,  $0.795 \pm 0.111 \text{ g/cm}^2$  for the Femoral Neck,  $0.698 \pm 0.103 \text{ g/cm}^2$  for the Trochanter, and  $1.096 \pm 0.137 \text{ g/cm}^2$  for the Intertrochanter region of interest. The figure shows a comparison of the T-scores for Femoral Neck regions calculated using the CTXA Hip areal BMD, volumetric BMD data, and the published NHANES III data.

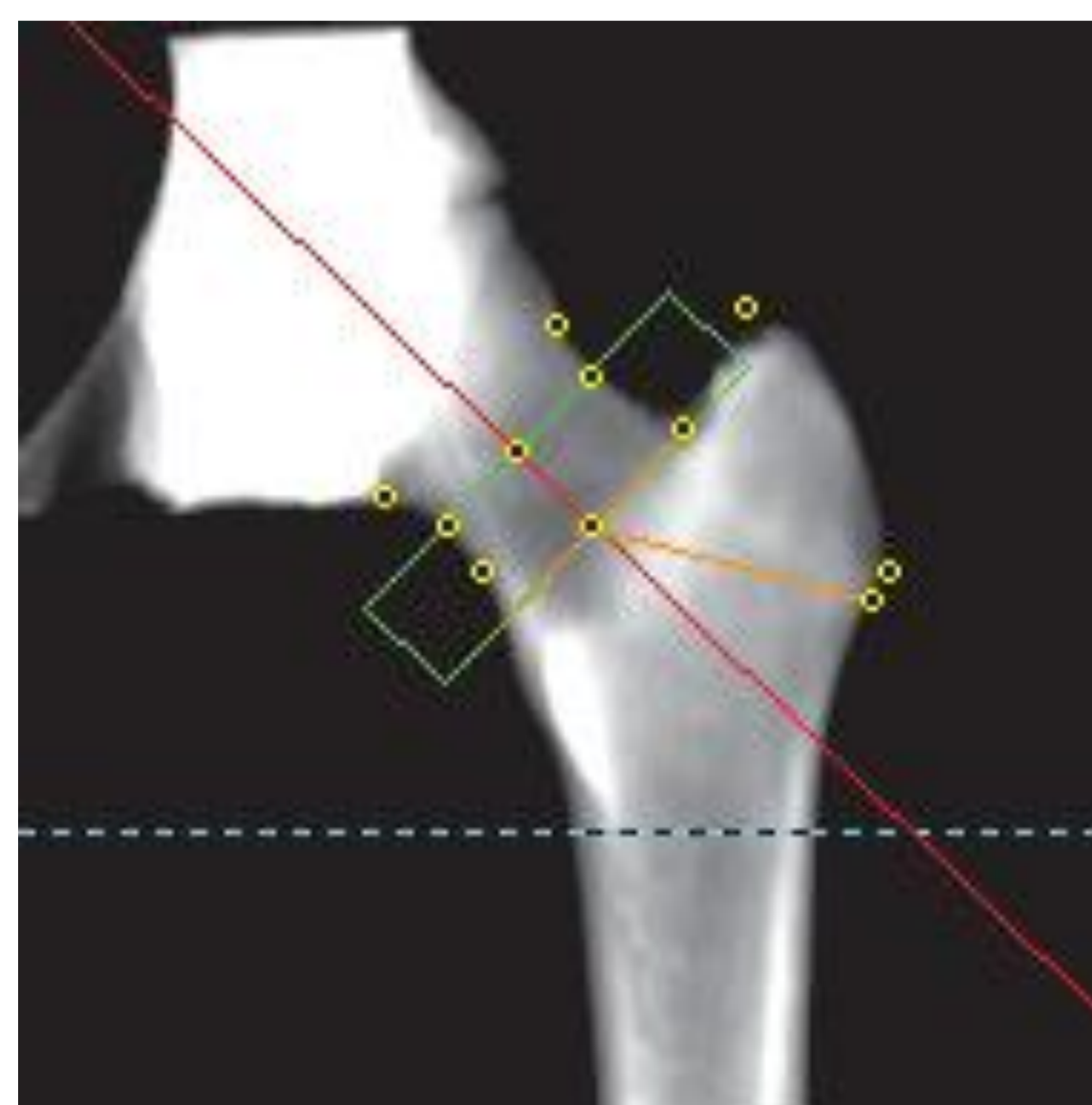


The T-scores for standard CTXA in the reference data presented here overlap the previously published NHANES III reference data almost identically. Femoral neck volumetric BMD not projected to 2D diverges from the others with increasing patient age.

## Methods

Our prospective cohort consisted of 616 women, aged 20-79, who were scanned at 11 centers geographically distributed across three regions of the U.S.: 3 locations on the West Coast, 4 locations in the Midwest, and 4 locations in the Northeast. Women with diseases known to affect bone metabolism were excluded. CT image data were analyzed in a standardized fashion with the CTXA Hip software, using the left proximal femur unless pathology prevented it. The analytical regions of interest were calculated in a DXA-like format using the standard femoral neck, trochanter, intertrochanter and total hip. Both area-based ( $\text{g/cm}^2$ ) and volume-based ( $\text{mg/cm}^3$ )

data are presented for these regions of interest. T-scores were calculated for CTXA Hip and NHANES III data sets based on a 20-39 year old reference group and areal BMD.



CTXA uses 3D quantitative CT (left) projected to 2D regions of interest (above) to calculate T-scores equivalent to those of a dedicated DXA unit. The CT images can also be used to find volume-based measurements of the bone, such as cortical thickness (right).

## Conclusions

Area-based T-scores calculated using the CTXA Hip method and considered as a function of age based on the reference data presented here are virtually identical to the T-scores obtained from the published NHANES III data. This similarity indicates the method can be used with the current WHO guidelines for diagnosis of osteoporosis in the same way DXA T-scores are used. CTXA Hip provides substantially the same clinical information as conventional DXA, and in addition goes beyond 2D projections to provide estimates of volumetrically derived parameters which may be useful in evaluation of bone strength.

