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Sensitivity of Bone Mineral Density Measurements to Axial Rotations and Scan Analysis in Dual Energy X-Ray Absorptiometry of the Lateral Distal Femur

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INTRODUCTION

- Dual energy x-ray absorptiometry (DXA) is the current standard for measuring bone mineral density (BMD) as it offers quick scan times with low radiation dose.
- When scanning the hip or spine of non- or minimally-ambulatory patients, surgical implants or severe contractures can limit the ability to produce accurate and repeatable measurements for tracking BMD over time.
- The lateral distal femur is being studied as an alternative scanning location, particularly in pediatric patients, to avoid these problems[1] (Fig. 1).

PURPOSE

- To determine the sensitivity of BMD measurements using DXA in a cadaveric study: i) due to the effect of axial rotations of the femur that occur when positioning the patient; and ii) due to the effect of selecting the region of interest (ROI) when analyzing the DXA scan.

METHODS

To determine the effects of axial rotation:
- Specimens were then scanned at 0, 1, 2, 5, and 10 degrees of internal and external rotation using a GE Healthcare Lunar IDXA System.
- The DXA scan was analyzed using a region selected following the protocol by Henderson et al.[2] (Fig. 2B).
- A paired t-test with significant level of 0.05 was used to determine a difference between the neutral position and each axial rotation (±1, 2, 5, 10).

To determine the effects of ROI selection:
- The ROI was translated in a vertical direction by ±1, 2, 3, 4, and 6 mm from the initial position (Fig. 3A).
- The ROI was translated in a horizontal direction by ±1, 2, 3, and 4 mm from the initial position (Fig. 3B).
- A paired t-test was used to determine a difference between the initial ROI position and each horizontal and vertical displacement.

RESULTS

- A significant difference in percent change in BMD was found between the neutral position and 2, 5, and 10 degrees of internal rotation (p=0.04, p=0.05, p=0.01, respectively).
- No significant difference in BMD was found between the neutral position and any of the external rotations.
- Mean percent change in BMD was 2.4±0.89% and 0.88±0.22% for internal and external rotation, respectively.

CONCLUSIONS

- Bone mineral density measurements are affected by the apparent change in the projected cross-sectional area caused by axial rotations of the femur and by the positioning of the ROI during scan analysis.

CLINICAL RELEVANCE

- Variability in patient positioning and ROI selection by the DXA technician may affect the BMD measures in longitudinal studies of pediatric patients.
- This may affect course of treatment defined by the physician.
- This study supports the need for a bracing system that can assist with repeatability in patient positioning for longitudinal scans.

REFERENCES


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