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Computed tomographic measurement of femoral torsion/anteversion: reliability and comparison of two methods

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INTRODUCTION
Femoral torsion and anteversion are frequently considered synonymous due to the lack of diaphyseal bony landmarks.[1] Femoral torsion can be calculated from craniocaudal and lateromedial femoral radiographs, or assessed directly from axial femoral radiographs, MRI or CT scans. Post-scanning reconstruction of the native CT scan permits correction for sub-optimal limb positioning and could potentially eliminate some of the concerns relating to difficulty of positioning and positioning reproducibility that affect radiographic techniques.[1] This study examined repeatability and reproducibility of two femoral torsion measurements with different proximal axis definitions, using CT scans of anatomic bone specimens.

MATERIALS AND METHODS
CT scans of paired femora (n=20) were obtained with slice thickness of 2mm, B31s kernel and a 512 x 512 matrix. Limbs were positioned to mimic body alignment in sternal recumbency. Multiplanar reformatting was performed by independent observers based on defined criteria to produce axial views for torsion measurement. Using the free viewing software ImageJ, femoral torsion was measured using a proximal axis joining either the centre of the femoral head and the centre of the femoral neck (method 1) or the centre of the femoral head and the centre of the diaphysis (method 2), and a distal axis joining the most caudal aspects of the two femoral condyles (both methods).
Data were compared using the within-subject standard deviation.[2] Methods were compared using Bland-Altman difference charting.[3]

RESULTS
Within-subject standard deviations for intraobserver repeatability were 2.1-2.2° for method 1 and 0.9-1.3° for method 2. Interobserver within-subject standard deviation was 3.4° for method 1 and 1.8° for method 2. The within-subject standard deviation defines a range about the expected true value within which 68% of measurements should fall. Repeated measurements should fall within 9.7° (method 1) or 5.0° (method 2) of each other in 95% of cases. The average difference between values obtained with methods 1 and 2 was approximately 2°. The corrected limits of agreement had a range of approximately ±7.5° about this average difference.

CONCLUSION
Use of the femoral diaphyseal landmark to define the proximal axis (Method 2) was more reliable than use of the femoral neck. Based on the Bland-Altman analysis, the two methods should probably not be used equivalently.

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