

Short communication

A comparison of ultrasound to goniometric and inclinometer measurements of torsion in the tibia and femur

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Abstract

Background: Torsions in the tibia and femur are important measurements for clinicians and researchers. A safe, accurate and time efficient tool is needed to advance the study of torsion. This study compared ultrasound and goniometric measures of torsion and also determined the repeatability of the goniometric techniques.

Methods: 19 females and 15 males (68 limbs) aged 19–69 years were studied. The transmalleolar axis, thigh–foot angle, and femoral torsion were measured with goniometers and compared to ultrasound measurements of tibial and femoral torsion using simple regression. Goniometric measures were measured twice to determine reliability.

Results: Goniometric measures of torsion were found to be reliable (intraclass correlation coefficients range: 0.84–0.90). Goniometric measurements had a weak to moderate significant relationship to ultrasound measures (standardized beta coefficient range: 0.56–0.70).

Discussion: Ultrasound and goniometric methods both provide useful measures of torsion; ultrasound may be more suitable for research and pre-operative planning.

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Keywords: Ultrasound; Goniometry; Torsion; Tibia; Femur

1. Introduction

Abnormal lower limb torsions have been linked to excessive intoeing, patellar mal-tracking, and osteoarthritis [1–4]. Both in the clinical and research settings techniques that are safe, accurate, fast, and inexpensive are required. The purpose of this study was to compare goniometric to ultrasound measures of tibial and femoral torsion.

CT and MRI are broadly considered gold standards in measuring tibial and femoral torsion. However, a review of the commonly cited studies indicates that *in vivo* validity has not been clearly established for either method [5–8]. In addition, CT and MRI are expensive and require considerable time for data processing, and CT emits harmful radiation.

Ultrasound compared well to CT [9] and biplane radiography (femur) [10] during studies of dry bones or on MRI of

patients [7]. *In vitro* and *in vivo* reliability has been reported to be good to excellent in a comparison of ultrasound to anatomical measures made following dissection and small differences were reported (0.5–1.5°) [11].

Goniometers and inclinometers are familiar tools to most clinicians. Milner and Soames [12] studied four techniques for measuring tibial torsion using goniometers and calipers. They found low repeatability and poor correlation with a direct measurement following dissection. Davids et al. [13] reported poor accuracy of measuring femoral torsion using a goniometer compared to CT. However; Ruwe et al. [14] found their goniometric method of measuring femoral torsion to be more accurate than using radiographs or 2D-CT when compared to *intra-operative* measures.

This study compared ultrasound and goniometric measures of torsion. Goniometric measures would be preferred for clinical practice as they are less expensive and readily available. The validity and reliability of ultrasound has been reported previously [11]; therefore the reliability of goniometric measures of torsion was determined in this study.

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