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THE BICONDYLAR ANGLE IN MODERN HUMANS AND ITS RELATIONSHIP TO STRESSES AND LOCOMOTOR ECONOMY

By

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Abstract

The bicondylar angle (or "carrying angle") evident in the distal femur of humans and fossil hominins has been suggested to increase the efficiency of bipedal walking by placing the foot closer to midline, below the body's center of mass, during stance phase. In this study, coronal-plane hind limb joint moments and metabolic cost during walking were analyzed to determine whether knee-joint stress or economy is correlated with carrying angle. Moments at the knee in the coronal plane were assessed via a combined modeling and experimental approach. Seventeen subjects (8 males, 9 females) walked along a trackway with an embedded force plate while kinematics and kinetics were recorded; inverse dynamics were used to calculate joint moments. Simulating a reduction in bicondylar angle, the distance between the center of rotation relative to the vertical ground reaction force was increased from the observed condition. Analyses confirmed that simulated coronal-plane knee moments, and thus knee-joint stresses, were greater in the decreased angle conditions, indicating that the normal bicondylar angle reduces knee joint stresses. In a separate study of n=26 subjects, bicondylar angle, determined via magnetic resonance imaging, and walking cost, measured via respirometry, are compared. Bicondylar angle was not significantly correlated with mass-specific walking cost in these subjects. The implications of these results for interpreting lower limb skeletal adaptations in the hominin skeletal record are also discussed.