EFFECTS OF VARIOUS BIOMECHANICAL ERRORS ON COMPUTED JOINT KINETICS VALUES

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INTRODUCTION: Inverse dynamics analysis has been widely used to evaluate the joint kinetics during various human movements. Several investigators have reported that the joint kinetic computations could be considerably affected by diverse biomechanical errors. Kim et al (2007) clarified the influence of measurement errors of Center of Pressure (CoP) location of force platform on calculated three-dimensional (3D) lower limb joint moment during walking. However, it is not yet clear how biomechanical errors, such as errors in CoP, Body Segment Parameters (BSP) and Joint Center Location (JCL) data, affect the calculated joint kinetics values. The purpose of this study was to clarify the influences of the alterations of anthropometric, kinematic, and kinetic variables on the magnitude and time-series curve patterns of the 3D ankle joint moment during human running.

METHOD: Kinematic and kinetic data while running (4.1m/s±0.1m/s) were obtained for one healthy male subject (age: 25yr, height: 1.68m, body mass: 64kg), who had no current lower extremity injuries. Using inverse dynamics procedures, 3D ankle joint moments were computed for five successful trials. Thereafter, the recalculations of joint moment were carried out under following conditions: (1) using the location of the CoP shifted in the anterior-posterior and medial-lateral direction with±5% and ±10% of range of CoP location; (2) for rigid body segment models with five different BSP models (Vaughan, Ae, Chandler, Zatsiorsky and DeLeva); and (3) using altered ankle JCL in the anterior-posterior direction with the distance of ±5% and ±10% of length from ankle joint center to midpoint of the 1th and 5th metatarsal.

RESULTS: Alterations of the ankle JCL and CoP in the anterior-posterior direction largely affected the values of dorsiflexion/plantarflexion moment of ankle joint. Changes of the magnitude of the moments resulting from the difference in BSP values were small in every direction. The frontal/horizontal-plane moments calculated with CoP errors were much larger than those with BSP and JCL errors. As for the frontal-plane moment with CoP errors in the medial-lateral direction, not only the magnitude of moment value but also a different time-series curve patterns were observed.

DISCUSSION AND CONCLUSION: The results of this study clearly showed that the alterations of the biomechanical parameters, which simulate the measurement errors both in kinematics and kinetics, such as errors in JCL and CoP, had significant influence on the 3D ankle joint moment obtained through inverse dynamics procedures. The results suggest that we should pay close attention about the level of the experimental errors to get meaningful results in using inverse dynamics procedures.

REFERENCES:

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