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Sitting Direction Assessment Using Center of Pressure Measured from Force Plate

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ABSTRACT

Consistency in the sitting direction contributes to decreasing the intra-subject variability in monitoring interface pressure using pressure mat during sitting. To maintain consistency, it is required to perform the test in a way that the body's sagittal plane has a stable alignment with the pressure mat coordinate system (CS). Current methods employed to maintain a repeatable sitting direction on pressure mat during the test sessions mostly rely on the visual checkups or using motion capture systems requiring tedious marker placement and data processing.

The objective of this study was to explore the assessment of sitting direction using center of pressure (COP) measured from force plates, which are the gold standard for the measurement of the excursion pattern of COP.

We asked 5 participants to perform trunk bending forward and backward 10 times in the anterior direction with a minimum of 75 degree while the force-plate measured the COP in its own CS. The entire test was repeated once more for each participant. Then, the offset angle between the anatomical CS and the force plate's CS was calculated based on the principal component analysis of COP measured in the force plate's CS. The obtained offset angle was used to quantify the differences of sitting directions expressed in the CSs of the force-plate and the body's anatomical CS.

To validate the ability of using COP in assessing the sitting direction, each participant performed trunk bending forward and backward in 5 different directions with 0, 10, 20, 30, 40-degree offset with respect to the CS of the force plate. Then the offset angle calculated based on the COP was compared with the angle targeted sitting direction from 0 to 40 degree. The experimental results indicated that the calculated offset angles were close to the targeted angles (0, 10, 20, 30, 40-degree) with a mean (standard deviation) of 1.7 (1.4), 1.2 (2.0), -0.8 (0.9), 2.5 (5.0) degree, respectively, of difference for each target angle. Also, our proposed method generated offset angles with mean (standard deviation) of 3.5 (2.3) degree when the sitting direction was aligned with the CS of the force plate. This could be caused by the natural offset angle of voluntary trunk bending angle with the body sagittal plane. In conclusion, the proposed solution could be used to improve the consistency in the measured sitting direction. In the future, the efficiency of the COP obtained from a pressure mat to obtain sitting direction should be investigated.