INTRODUCTION

Instantaneous inclination angles between the whole body center of mass (COM) and center of pressure (COP) during gait were reported to detect gait instability in the elderly [1]. Accurate calculation of the COP requires a single foot placement on each force plate. However, many studies indicated that older adults, especially fallers, walk with a significantly smaller step than young adults [2,3]. Such gait modification and inter-trial inconsistency of this population greatly increase difficulty in obtaining a clean foot placement on the force plate, which will obstruct the use of COM-COP inclination angles in clinical settings. Therefore, the purpose of this study was to find an alternative parameter, similar to COM-COP inclination angles, for assessing instantaneous alignment between COM and base of support during gait without concerning the subject’s ability in making proper foot contacts with the force plate. Effectiveness of using the inclination angle formed by the lateral ankle marker and COM during gait to distinguish patients with imbalance was assessed in this study.

METHODS

Four elderly patients with gait imbalance (mean age = 78 ± 4.7) and four matched elderly controls (mean age = 77.8 ± 6.7) were recruited for this study. Subjects were asked to walk on a level surface with self-selected pace while barefoot. Whole body motion data was collected with an 8-camera motion analysis system (Motion Analysis Corp., Santa Rosa, CA). A total of 29 markers were placed on the subject’s bony landmarks [4]. Two force plates (AMTI, Watertown, MA) were used to collect ground reaction forces for the calculation of COP. Inclination angles of the lines formed by the COM and lateral ankle marker as well as by the COM and COP were computed for each frame during the single stance phase of a stride. The effect of subject group on average inclination angles during this time period were assessed using a two-sample *t*-test with an a level of 0.05.

RESULTS

Representative profiles of medial inclination angles during the single support phase from a patient and a control subject were shown in Fig 1. COM-Ankle medial inclination angles were consistently greater than COM-COP inclination angles. Average medial COM-Ankle and COM-COP inclination angles of imbalance patients were 6.8° ± 1.1° and 5.1° ± 0.5°, respectively. Average medial COM-Ankle and COM-COP inclination angles of healthy individuals were 4.9° ± 0.9° and 2.9° ± 0.9°. Patients were found to display significantly greater inclination angles than healthy elderly (p=0.039 for COM-Ankle angle; p=0.004 for COM-COP angle; Fig. 2).

DISCUSSION/CONCLUSION

Compared to the medial COM-COP inclination angle, a greater medial COM-Ankle inclination angle is expected due to the lateral ankle marker’s location. Findings from this study demonstrated that the medial COM-Ankle inclination angle during the single stance phase, similar to the COM-COP inclination angle, could successfully distinguish patients with gait imbalance. Calculation of the COM-Ankle inclination angle will not require a proper foot placement on the force plate of the subject, which could be a more assessable biomechanical parameter for quantifying gait stability in clinical populations. Currently, more subjects have been investigated to strengthen this conclusion.

REFERENCES


ACKNOWLEDGEMENTS

Technical assistance from Vipul Lugade is greatly appreciated.