Principal component analysis: Joint kinematics features

Y. KOBAYASHI, H. HOBARA, M. MOCHIMARU. ***Principal component analysis: Joint kinematics features during overground walking in elderly fallers.*** *Gerontechnology 2014;13(2):225;* doi:10.4017/gt.2014.13.02.203.00 **Purpose** Falls by the elderly are a major public health problem all over the world[1]. A recent study reported that the variability of minimum toe clearance (MTC) is positively correlated with the variability of joint angles at the instance of MTC[2]. However, this study only analyzed the relationship between MTC and joint kinematics at the instance of MTC. Therefore, how the risk of falls is related to joint kinematics of the lower limb at each instance of entire gait cycle remains unknown. The objective of present study was to identify the key characteristics of joint kinematics of gait as it is related to the risk of falls when a participant is walking. **Method** Joint kinematics data were obtained from 18 participants who had recently fallen and 19 who had not; data were analyzed using principal component analysis (PCA). PCA has been conducted on the input matrix that was constructed from time-normalized lower limb joint angle average data and standard deviation of three planes (101 data points×two parameters×three angles×three planes). **Results & Discussion** As a result, PCA identified only five principal component vectors (PCV) of more than 20 PCVs generated related to fall risk. These results indicate that joint kinematics related to the five PCVs are the key characteristics of joint kinematics during walking that are relate to fall risk. Therefore, we recombined the joint kinematics corresponding to the five PCVs, and identified larger joint kinematics variability from the late stance to the early swing phase for those patients who had a history of falling compared to those who had not fallen regardless of joints (*Figure 1*). Further, those who had previously fallen tended to show smaller hip flexion and ankle dorsi-flexion angle, and larger ankle inversion angle during the mid to late-stance phases, and a smaller hip abduction angle during the mid-stance phase which must result to a smaller toe clearance (*Figure 2*). A previous study reported that special garments could enhance the joint position senses[3]. Hence, both present and past findings[3-6] suggest that a reduction of the variability in joint kinematics during the late stance to early swing phase through the use of special garments or footwear may reduce the risk of falls.

References

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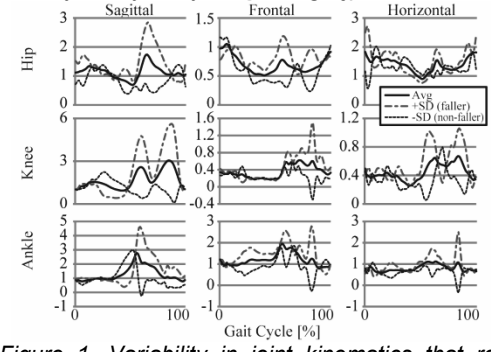

Figure 1. Variability in joint kinematics that recombined from the PCS of five principal component vectors

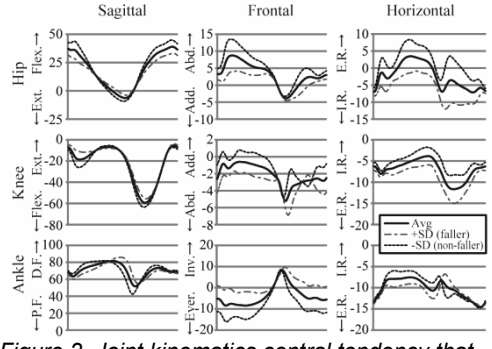

Figure 2. Joint kinematics central tendency that recombined from the PCS of five principal component vectors