The influence of aging on human postural control mechanisms

K. TANIGUCHI, A. TAKANISHI. ***The influence of aging on human postural control mechanisms.*** *Gerontechnology 2014;13(2):288;* doi:10.4017/gt.2014.13.02.123.00 **Purpose** This study aims to reduce the risk of falls in older people by elucidating the mechanisms of human postural control. Postural balance, which was measured by stabilometer, was suggested as an important risk factor for falls[1]. It has been proposed that intermittent control provides a framework to explain human postural control[2], usually together with continuous control. We suggest that an event trigger for intermittent control is related to behaviour of the Center of Pressure (COP) movement around Root Mean Squared area (RMS). We investigated whether those COP parameters were influenced by aging. **Method** Subjects were 41 middle and old age (aged 37-85 years, mean=64.5 years (SD=12.6)). The subjects stood on a stabilometer (the Nintendo Wii Balance Board: WBB). The WBB is a portable, inexpensive, and reliable device that has been reported by many to have good validity for assessing standing balance[3]. The COP sway was recorded (sampling frequency, 50Hz) for 30s. The participants stood with their feet together, eyes open, and hands at their sides. Informed consent was obtained from all participants. The parameters were derived from the COP values (*Figure 1*). They were evaluated both for intra-RMS (IRMS) and extra-RMS (ERMS). Originally 12 parameters were translated by Principal component analysis (PCA). In this study, we show a comparison with principal component scores for IRMS and ERMS. **Results & Discussion** *Table 1* shows the highest factor loading on each principal component. The SDVEL (x-axis) is significant factor of the COP (factor loading>0.95). To explain the difference in behaviour between IRMS and ERMS, we evaluated the differential value of principal component score. *Figure 2* shows the distance of three dimensional coordinates(x=PC1, y=PC2, z=PC3) between IRMS and ERMS versus the age. These results show an age-related increase in the distance of parameters between intra-RMS and extra-RMS for the COP. These distance measures are significantly related to postural control. The value of distance may be one of the indicators of fall risk.

Table 1. The parameters of the first 3 principal components in the PCA: PC1, PC2, PC3; ERMS= extra Root Mean Squared area; IRMS=intra Root Mean Squared area; loadings in parentheses

Parameter			ERMS	IRMS
SD	VEL: Velocity	x-axis	PC1(0.97)	PC1(0.98)
		y-axis		
		length		
	ACC: Acceleration	x-axis		
		y-axis		
		length		
M	VEL: Velocity	x-axis		PC3(0.53)
		y-axis	PC3(0.80)	
		length	PC2(0.59)	
	ACC: Acceleration	x-axis		
		y-axis		PC2(0.68)
		length		

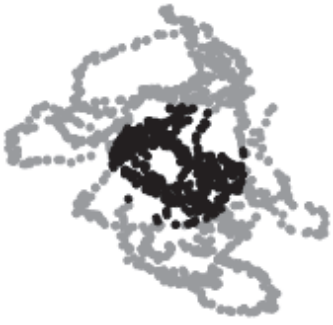

Figure 1. The COP sway; extra (grey) and intra (black) RMS (Root Mean Squared area)

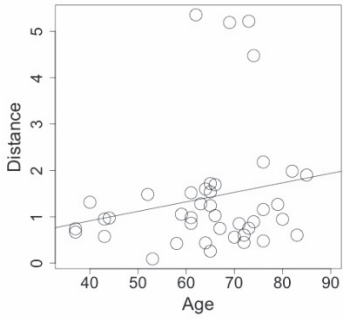

Figure 2. Age-related changes in postural sway

References

1. Piirtola M, Era P. Gerontology 2006;52(1):1-16; doi:10.1159/000089820
2. Gawthrop P, Loram I, Lakie M, Gollee H. Biological Cybernetics 2011;104(1/2):31-51; doi:10.1007/s00422-010-0416-4
3. Clark RA, Bryant AL, Pua YH, McCrory P, Bennell K, Hunt M. Gait & Posture 2010;31(3):307-310; doi:10.1016/j.gaitpost.2009.11.012

Keywords: mobility & transport, postural control, aging, principal component analysis

Address: Hiroshima International University, Graduate School of Waseda University, Japan
E: taniguti@hs.hirokoku-u.ac.jp