H. Takada, M. Takada, M. Miyao, M. Furuta, K. Tanaka, T. Shiozawa. Effects of galvanic vestibular stimulation on statokinesigrams of the elderly. Gerontechnology 2008; 7(3):329.
In humans, the standing posture is maintained by the body's balance function that has an involuntary physiological adjustment mechanism[1]. Aging causes deterioration in visual, auditory, and vestibular functions and in proprioceptive inputs from the skin, muscles, and joints[2,3]. The information received by these sensory receptors reduces with advancing age. It has been hypothesized that postural instability in the equilibrium function also increases with advancing age. Special suits have been designed to simulate the physical functions of the elderly. They comprise glasses with narrow visual fields to simulate poor eyesight, earplugs that reduce hearing ability, and weight loads that reduce movement ability. However, it has been suggested that these suits do not simulate the postural instability that is actually observed in elderly subjects[4]. We considered that postural instability in the elderly is caused by anomalous signals in the vestibules. By using galvanic vestibular stimulation (GVS) that can mask regular signals until they reach the vestibular nuclei, we verified this hypothesis and investigated the effect of GVS on the statokinesigrams (SKGs) of the elderly. **Methods** The subjects were healthy volunteers, and they were divided into 2 groups: the young group of age <22 years and the elderly group of age >64 years. In the subsequent stabilometric analysis, we recorded the center of pressure (COP) at rest and during GVS. (i) *Stabilometry*: For 1 minute before the sway was recorded, the subjects stood still in the Romberg posture with their feet together on the detection stand of a stabilometer (ANIMA, Japan). The COP sway was then recorded (sampling frequency, 20 hertz) at 25 degrees centigrade when the subjects stood with their eyes open (1 minute) and looked at a visual target at a distance of 3 meters or when their eyes were closed (the following 1 minute). SKGs were simultaneously recorded using the stabilometer. (ii) *GVS*: An electric current was percutaneously applied on both sides of the mastoid processes through Ag/AgCl electrodes. We set the amplitude of the electric current to the maximum values obtained in the anti-GVS test[5], which varied among subjects. **Results and discussion** We analyzed the following indices on the SKGs: the area of sway (S), total locus length (L), L/S, total magnitude of acceleration (A), A/L, sparse density (SPD), and the total locus length involved in the chain (LC)[4]. In order to compare between the SKGs recorded when the subjects stood with their eyes opened and those recorded when the subjects had their eyes closed, we calculated the Romberg ratio for the indices under the following conditions: (i) the young group at rest, (ii) the elderly group at rest, (iii) the young group with the GVS load, and (iv) the elderly group with the GVS load. According to the results of the Friedman tests, the Romberg ratio was not affected by the GVS load. However, L, A, and LC were found to increase significantly with advancing age. In conclusion, postural instability in the elderly may be improved by the presence of visual information.

References

1. Okawa T, Tokita T, Shibata Y, Ogawa T, Miyata H. Equilibrium Research 1995;55:283-293
2. Goto A. Journal of Otolaryngology of Japan 1992;95:164–171
3. Diener HC, Dichgan J. Progress in Brain Research 1988;76:253-262
4. Takada H, Kitaoka Y, Iwase S, Shimizu Y, Watanabe T, Nakayama M, Miyao M, Mihashi K. Environmental Medicine 2003;47:85-89
5. Takada M, Yamauchi T, Tanaka K, Shiozawa T, Furuta M, Miyao M, Kitaoka Y, Takada H. Japanese Journal of Ergonomics 2007;43:S230-S231 [In Japanese]

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