

gastrocnemius (GC) with electromyography (EMG). The followings were observed: 1) There were no significant differences between gait characteristics of tandem gait and normal gait, although gait speed of tandem gait was significantly slower than normal gait ($p < 0.001$). 2) In integrated EMG (iEMG), GM were more explicit and constant during tandem gait of stance phase compared to normal gait. 3) The iEMG of GM during tandem gait was significantly greater than normal gait ($p < 0.01$). Classically, as gait speed decreases, the stance percentages and the double stance percentage progressively increases. The present gait cycle study indicates that gait characteristics of tandem gait remain the same as normal gait while gait speed of tandem gait is slower than normal gait. Judging from the EMG study, tandem gait is not only a helpful and sensitive clinical test but useful and safer for muscle strength exercise of hip adductor.

PA3-1 Recognition of Motions Based on the Coarse-grained Electromyogram

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The purpose of this study is to recognize the movement of human beings by a simple method from an electromyogram (EMG). A coarse-grained EMG was used to recognize one's motions as a record of human behaviors experimentally. Six healthy university students participated in this experiment as subjects. EMG and the video of motions were recorded on a PC when PET bottles with different weights were lifted up with various speeds and directions. The EMG was derived from the skin surface of the musculus biceps brachii, deltoid, extensor digitorum and flexor digitorum profundus. The actual times of the motions were measured from the video image by the behavior observation program "Observant Eye". The root-mean-square (RMS) of the EMG was coarse-grained by a special equation. As a result of analysis, the minimum value of the RMS of the EMG wave of the deltoid appeared nearly at the starting time to lift up the bottles. There was only a small influence from the weight and direction for the detection of the lifting movement. Furthermore, the prototype program was prepared, which can easily recognize one's lifting motions by the EMG. Compared to the recognized motions of the deltoid and actual motions of fetching goods during checker work when recognized by the EMG, about 60.8% of the average recognition rate could be obtained. There is a need to study recognition of movement by plural muscle combinations in the

future to enhance the recognition rate.

PA3-2 The Effect of Aging on the Backward Stepping Reaction from the Velocity of Center of Foot Pressure and Muscular Strength

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This study aims to prove that the characteristics of the backward stepping reaction in the elderly are related to the strength of the antigravity muscles by estimating the deflection velocity from the center of foot pressure (COP). Ten elderly (average age 75.6 ± 7.6 years) and thirteen young (average age 22.0 ± 2.6 years) subjects participated in this study. We measured the shift in the deflection velocity (V-RMS) and the maximum deflection velocity (V-MAX) from the start of COP to the onset of the stepping reaction by force plate analysis. In addition, we measured the strength of the antigravity muscles using hand-held dynamometer. We correlated the V-RMS, V-MAX, and the rate of change of deflection velocity (MAX/RMS) to the muscular strength. When compared with the young subjects, the elderly showed significantly lower values of V-RMS ($p < 0.05$) and significantly higher values of MAX/RMS ($p < 0.01$). Furthermore, the elderly showed significantly lower values of muscular strength for all muscles when compared with the young subjects ($p < 0.001$). We established a significant correlation between V-RMS, MAX/RMS, and muscular strength by carrying out regression analysis (V-RMS: gluteus maximus ($r = 0.50$, $p < 0.05$); rectus abdominis ($r = 0.48$, $p < 0.05$); and MAX/RMS: adductor magnus ($r = -0.66$, $p < 0.001$); and flexor digitorum longus ($r = -0.62$, $p < 0.01$)). Differences in the V-MAX and MAX/RMS during the backward stepping reaction were observed, and it was suggested that these differences related to the age of the subjects and their muscular strength. Therefore, we suggest that further investigations should be performed in order to understand the effects of aging on the stepping reaction, i.e., the change-in-support strategy, including the preparatory phase of stepping reaction, and the relationship with muscular strength should be further investigated.

PA3-3 Foot Trajectory Pattern and Perception of Foot Position while Stepping over an Obstacle in the Elderly