

Muscle Activity Analysis Focused on Differences in Lower Limb Motion in Applying Automotive Pedal

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A Considering that the linearity between braking pedal force and soleus muscle activity is an important factor for improving operability, we analyzed how the lower limb muscle activity changes with differences in lower limb motion and operating force point caused by the direction of a pedal movement. Two types of commercial vehicles (Vehicles I and II) with pendant-type brake pedals and different installation geometries were used in this study. The experimenter instructed the subjects to "operate the brake pedal of the Test Vehicle I with the heel fixed and a ball of the foot" (Pattern ①; Fig. 1-a). On the other hand, when using the Test Vehicle II, subjects were instructed to "operate the brake pedal with heel fixation & toe " (Pattern ②; Fig. 1-b) and "operate the brake pedal with heel shift" (Pattern ③; Figure 1-c). Electromyograph sensors were attached to measure the electromyographic (EMG) potentials of the lower limb muscles during brake

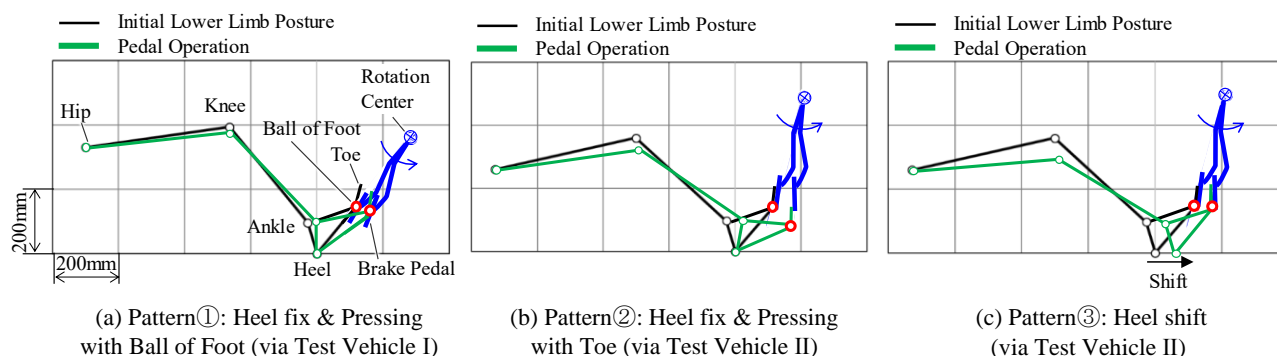


Fig.1 Images for Pedal and BOF Movements per Pedal Operation Patterns (①~③)

pedal application, including a soleus muscle.

The coefficient of determination (R^2) between braking pedal force and soleus EMG was obtained from the data of 10 trials for each operation pattern for 4 subjects (Fig. 2). The coefficient of determination was high for the Pattern ① in all four subjects. Similarly, the coefficient of determination was high for the Pattern ②. In 2 out of 4 subjects, the coefficient of determination showed a significant high for the Pattern ① compared with the Pattern ②. The coefficient of determination for Pattern ③ varied widely and tended to be lower than those for the Pattern ① and ②.

The above results indicate that when the direction of a pedal movement and a ball of the foot motion are matched, the operation is performed with heel fixation and ankle plantar flexion, and a ball of the foot plays a role of the operating force point to press a pedal. This effect was found to be highly linear between braking pedal force and EMG of soleus.

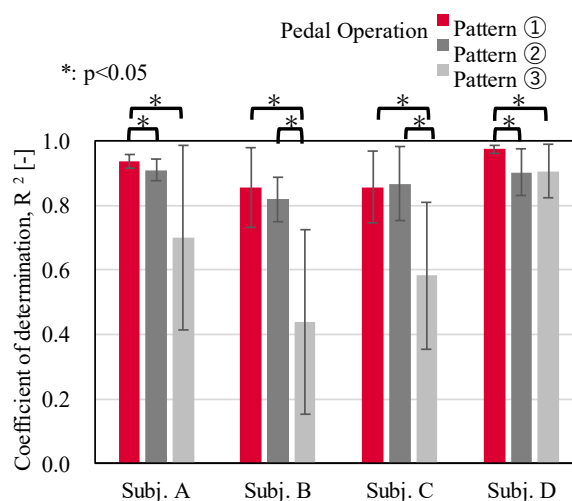


Fig.2 Coefficient of determination between Braking Pedal Force and EMG of Soleus per subjects