The Impact of Muscle Fatigue and Body Equilibrium of the Elderly

Using Different Length of Cane on Getting Down in Different Height of Stairway.

Chinmei Chou (Yuan Ze University, Taiwan),
Zi-Ying Li (Yuan Ze University, Taiwan)

1. Introduction

As people aging, physiology of human being has been degenerating continuously. This phenomenon often impacts elderly not only in daily activity but psychology. Elderly have higher possibility to fall down as a result. According to previous study, staircase was a major place where fall accident happened and caused serious consequence [1]. Using cane is one of ideal method to help elderly walk smoothly and reduce fall accident. However, there were few research regarded between stair environment and cane length. Thus, the study is to explore the impact of the elderly when using different length of cane on getting down in different height of stairway.

2. Methods

The average age of this research was 82.17 years old which included 5 male and 4 female. Participants were asked to use different length of cane in getting down staircase. There were four types of cane length. First type was the floor to the greater trochanter [2] (Cane 1). Second type was the floor to the distal wrist crease [3] (Cane 2). Third type was shorter one which elbow flexed lower 20 degree (Cane 3). The last was no use cane (Cane X). Stair height included 0cm (ground level), 18cm, 27cm and 33cm. Participants were measured EMG (Electromyography) signal on arm which usually held the cane and both Gastrocnemius. Besides, COP (Center of pressure) was measured through force plate.

Total length of experiment time was 38 minutes (Fig. 1). Participants were asked to sit down for 15 minutes having a break and then began to conduct test from 1 to 4. Each test was conducted by standing on different height of stair with various length of cane randomly then got down on force plate and stood over 10 seconds. After test was done, participants had 5 minutes break. All participants must conduct 4 tests every day and finished whole experiment by 4 days.

<table>
<thead>
<tr>
<th>Description</th>
<th>5 mins</th>
<th>Break</th>
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<tbody>
<tr>
<td>Test 1</td>
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<tr>
<td>Test 2</td>
<td>0'15</td>
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<td>Test 3</td>
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<td>Test 7</td>
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<td>Test 8</td>
<td>0'36</td>
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<td>Test 9</td>
<td>0'38</td>
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Fig. 1 Experimental procedure

3. Results

We used ANOVA to analyze collected data. EMG data was transformed to RMS (root mean square, RMS) value and COP data was transformed to Stabilometric Parameters. Both EMG and COP data were classified into two periods. One was loading response period the other was standing period. Loading response was defined as when participant’s feet contacted force plate. Standing period was defined as when participant stand on force plate during 5 seconds with both feet after stepping down stair. EMG data collected from legs were divided to first step which step down in the beginning and the other as second step.

According to the experimental results, loading response period for EMG arm and first step data had significant impact (p-value<.05) on different stair
environment, beside, In standing period, only arm of EMG data had significant impact (p-value<.05).

### 3.1 EMG (Electromyography, EMG)

#### Loading response period

Arm and first step RMS value had significant impact in stair height. As the stair higher, the RMS of arm in 27cm (value=1.01) and 33cm (value=1.17) were higher than 0cm (value=0.57) (Fig. 2); first step in 33cm (value=0.89) was higher than 0cm (value=0.53) and 18cm (value=0.48) (Fig. 3). All RMS value had no significant impact in cane length.

![Fig. 2 The RMS of arm in first stage](image)

![Fig. 3 The RMS of first step in first stage](image)

#### Standing period

RMS value of arm had significant impact in stair height. As the stair higher, RMS value of arm in 33cm (value=1.27) was higher than 0cm (value=0.45); the RMS of first step and second step had no significant impact. Also, all RMS value had no significant impact in cane length.

### 3.2 COP (Center of pressure, COP)

#### Loading response period

The Stabilometric Parameters MDIST, MDIST_AP, TOTEX, TOTEX_AP, MVELO and MVELO_AP had significant impact in stair height which 0cm was higher than 27cm. For figure 4 as an example, MDIST had significant impact in stair height and meant participants swayed larger in 0cm (value=69.86) than 27cm (value=31.21) stair environment. COP parameters had no significant impact in cane length.

![Fig. 4 The MDST of COP in first stage](image)

#### Standing period

The result showed that EMG and COP had no significant impact after participants getting down from stair.

### 4. Conclusions

4.1 Different stair height affected participants' muscle fatigue and body equilibrium, but different length of cane did not affected.

4.2 When participants used smaller strength on getting down stair, their body swayed larger relatively. Although participants swayed smaller in 33cm stair environment, they used larger strength in fact. Especially, we found 18cm stair environment could use smaller strength on first step and get better stability compare with 0 cm condition.

### Reference

