Analysis of walker-aided walking by the healthy elderly with a walker pocket of different weights attached at different locations

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Abstract. [Purpose] This study aims to provide information on safe walker-aided walking by analyzing elderly subjects’ walking with a walker pocket of different weights attached at different locations. [Subjects and Methods] Twenty elderly right-handed males participated in the study, and a walking analyzer was used to examine their walking with a pocket attached to the left, center, and right side of the walker. The weight of the pocket was set at three levels relative to the average weight of the subject group: 0% (without pocket), 2.5% (2 kg), and 5.5% (4 kg). [Results] In terms of the pocket location, step width was the narrowest when the pocket was attached to the right side, while the other elements of walking did not change. In terms of the pocket weight, all elements of walking showed changes. A heavier pocket led to a shorter step length and stride, a greater step width, and longer time. [Conclusion] When elderly people use a pocket-attached walker, the pocket is recommended to be attached to the right side of the walker, and its weight should be kept under 5.5% of the user’s weight to ensure safe walking. Key words: Elderly, Walker-aided walking, Walker pocket

INTRODUCTION

Canes and walkers provide support and balance, and they can help some people avoid falls1). Therefore, the use of personal assistance mobility devices is strongly recommended to keep the elderly independent2). As a walker requires both of a user’s hands to control, a separate walker pocket becomes necessary to contain the user’s personal belongings3). Some walkers are simple, whereas others are enhanced to have wheels or even a basket to help carry items. A walker pocket should not obstruct the operation of the walker, and it should be designed in a way that prevents the walker from falling down when the pocket is loaded to the maximum capacity. However, accidents related to safety and caused by elderly-friendly devices frequently occur, with half of the accidents involving falls3). A walker has four supporting points and a wide base that makes it relatively stable. However, when an external load is applied, the user’s walking pattern can be affected, as the center of gravity and the center of pressure shift. If balance disturbance occurs while the center of gravity is biased to one side due to the external load, the user might lose his/her balance and fall down on a sloped or an uneven surface. Therefore, using a walker is not perfectly safe due to this risk. This loss of balance could be a significant risk factor for elderly people, as they are exposed to increased risk of damage or fall4). In this study, we examine elderly people’s walker-aided walking with different locations and weights of the walker pocket to provide information on safe walker-aided walking.

SUBJECTS AND METHODS

The subjects were 20 elderly men (mean age: 75.67±4.27 years, mean height: 163.67±5.53 cm, mean weight: 61.08±7.38 kg) who lived in Kangwon-do, Korea. The inclusion criteria for the subjects were right-handedness, and no neurologic or orthopedic problems that could hinder walking, and no visual impairment5). All the subjects received sufficient explanation about the objectives of the study before the experiment and provided their consent to participation. This study was reviewed and approved by the Kangwon National University Institutional Review Board. All the subjects signed an informed consent form. First, the physical properties of the subjects were

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measured. Then, they were transported to a senior welfare center in town for the experiment. All the subjects wore casual clothes, and socks without shoes for the measurements. Before the experiment, the subjects performed sufficient stretching and a three-minute walking exercise with a walker to familiarize themselves with walking with the walker. The experiment began when the subjects could maintain natural walking. They started walking 30 cm before the start point of the walking analyzer. In this study, the WalkWay MG-1000 (Animaco, Japan) walking analyzer was used to measure the step length, stride, step width, and time according to the weight and location of the walking aid pocket. Moreover, a front-wheeled walker with non-skid tips on the back legs was used, and it could be pushed and moved forward by lifting the two back legs (Figs 1, 2).

In general, a walker handle should be located at the ulnar styloid when the user is in a standing position, with the arms relaxed and the elbow joint flexion at 15° to 20°. The walker is supposed to equal the height of the greater trochanter of the femur. However, a walker height one inch greater than the height of the greater trochanter of the femur has been reported to be more efficient in terms of gait speed, plantar prints on the paralyzed side, forward shift of the body's center, and contact area of the heel. In this study, the femur height of the subjects was measured, and the handle height was adjusted to one inch above it, with the elbow joint flexion angle set to 15° to 20°, similar to the conditions reported by Cha.

The walker pocket was a commercially sold fabric pocket made to hold personal belongings, such as glasses, notes, medicine, and mobile phone. It had dimensions of 29.8 cm × 27.3 cm × 2.5 cm and a weight of 454 g. To examine the effect of weight change on walking with the walking aid pocket in different locations, the pocket was attached to the left, center, and right sides of the walker, and the weight was altered in each case.

With reference to McGibbon, Kerbs, and Mann, the subjects were divided into three groups different pocket weights relative to the average weight of the group: 0% (no pocket), 2.5%, and 5.5%. Specifically, the first group used a walker without a pocket, the second group used a walker with a 2 kg pocket (average weight 61.08 kg × 2.5% + pocket weight 454 g), and the third group used a walker with a 4 kg pocket (61.08 kg × 5.5% + pocket weight 454 g). Data for each item from the walking analysis were processed using SPSS 20.0 for the statistical treatment of the data. Descriptive statistics were used for the general characteristics of the subjects. Two-way ANOVA was conducted to examine the differences among the three groups, depending on the location and weight of the walker pocket. The significance level was chosen as 0.05.

RESULTS

Two-way ANOVA was conducted to examine the changes in the subjects’ walking, depending on the location and weight of the pocket. For all the measured characteristics of walking, no correlation was found between the weight and the location of the walker pocket. Step width showed a statistically significant difference in the location of the pocket (p<0.01, Table 3), while no statistically significant difference was observed in all the other walking characteristics. Step width was the narrowest when the pocket was attached to the right side and the widest when attached to the left side. That is, walking stability was the greatest when the pocket was attached to the right side.

Statistically significant differences were found in step length, step width, stride, and time among different pocket weights (p<0.001, Tables 1, 2, 4; p<0.01, Table 3). The heavier the pocket was, the shorter the step length and the stride, the greater the step width, and the longer the time. In other words, as the pocket grew heavier, the subjects walked slower and with less stability.

DISCUSSION

This study examined the changes in walker-aided walking of elderly people elicited by different weights and locations of the walker pocket. The results show that step width was the narrowest and walking stability was the greatest when the walker pocket was attached to the right side of the walker. When the pocket was heavier, the gait speed and walking stability decreased. Walking stability was higher when the walker pocket was attached to the right side, presumably because all the subjects were right-handed, and their right limbs were accordingly dominant.

Generally, the use of a walker enhances walking efficiency by distributing the body weight to an aid device; thus, reducing the load on the muscles and joints of the lower limbs. However, an increased external load causes increased energy consumption and decreased step length and
Table 1. Step length according to the weight and the location of the walker pocket

| Weight*** | Position | Lt. | Rt. | Mid. |
|-----------|----------|-----|-----|------|
| 0 kg⁵     | 41.34±10.85 | 47.64±8.39 | 44.50±8.98 |
| 2 kg⁵     | 34.11±9.29  | 38.58±8.09  | 36.84±8.13  |
| 4 kg⁵     | 30.37±10.08 | 35.00±8.71  | 33.69±9.18  |

Post hoc c,b>a

*** p<0.001

Table 2. Stride according to the weight and the location of the walker pocket

| Weight*** | Position | Lt. | Rt. | Mid. |
|-----------|----------|-----|-----|------|
| 0 kg⁵     | 85.28±19.46 | 91.60±18.78 | 88.44±18.64 |
| 2 kg⁵     | 72.61±19.93  | 77.63±19.33  | 76.53±22.08  |
| 4 kg⁵     | 58.46±23.99  | 66.74±21.94  | 62.61±22.71  |

Post hoc c,b>a

*** p<0.001

Table 3. Step width according to the weight and the location of the walker pocket

| Weight** | Position** | Lt.¹ | Rt.² | Mid.³ |
|-----------|------------|------|------|------|
| 0 kg⁵     | 11.78±4.12 | 8.60±4.02 | 10.19±4.00 |
| 2 kg⁵     | 14.15±5.33 | 10.78±3.07 | 12.46±3.18 |
| 4 kg⁵     | 17.50±7.29 | 12.29±4.08 | 14.90±4.15 |

Post hoc a,b>c ; 3,2>2,1

** p<0.01

Table 4. Walking time according to the weight and the location of the walker pocket

| Weight*** | Position | Lt. | Rt. | Mid. |
|-----------|----------|-----|-----|------|
| 0 kg⁵     | 1.80±0.56 | 1.49±0.43 | 1.64±0.47 |
| 2 kg⁵     | 3.86±0.54 | 3.59±0.76 | 3.73±0.62 |
| 4 kg⁵     | 4.38±0.78 | 4.14±0.88 | 4.26±0.83 |

Post hoc a>b>c

*** p<0.001

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