



Original Article

Usefulness of a simulated experience method for transfer assistance for hemiplegia or limited range of motion in multiple joints

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Abstract. [Purpose] To further the understanding of dysfunctions to which a simulated experience method could be applied, we clarified whether a simulated experience method can promote caregivers to utilize the abilities of care recipients with pseudo-hemiplegia or pseudo-limited range of motion (ROM) in multiple joints. [Participants and Methods] We studied transfer assistance in 60 nursing assistants from nursing home settings: 30 were assigned to the pseudo-hemiplegia (26 females, 4 males) and limited ROM in multiple joints (27 females, 3 males) groups. One healthy person was fitted with orthotic braces to mimic hemiplegia or limited ROM in multiple joints, each making it difficult to stand-up. Participants were randomized to either a simulated experience group (involving interventional help from a physical therapist between the first and second measurements) or a control group. The load difference on the lower limbs of the care recipient between two rounds of transfer assistance was examined. [Results] The difference between the second and first measurements was -5.9 ± 74.5 N for the control group and 107.9 ± 123.6 N for the simulated experience method in the pseudo-hemiplegia study, and -14.7 ± 64.7 N and 149.1 ± 132.4 N, respectively, for the pseudo-limited ROM-in-multiple-joints study. [Conclusion] The simulated experience method promoted transfer assistance of a care recipient with pseudo-hemiplegia or pseudo-limited ROM in multiple joints. These results suggest that hemiplegia and limited ROM in multiple joints are added as dysfunctions that can be applied to a simulated experience method in transfer assistance.

Key words: Transfer, Simulated experience method, Assistance

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INTRODUCTION

In Japan, the number of people who require care in basic activities of daily living is increasing, with the figures exceeding 6.3 million including those need occasional support¹⁾. Wheelchairs are often provided for older people who have difficulty walking in nursing homes that are supported by long-term care insurance²⁾. Therefore, it is often necessary to provide assistance with the transfer to a wheelchair, but in these situations it is commonly concerned that the caregiver will take away the care recipient's opportunity for independent motion³⁾.

In Japan, transfer performance is generally subjectively evaluated in 7 levels as a Functional Independence Measure item⁴⁾. Meanwhile, we devised a method to objectively show the power that the care recipient exerts partially during transfer assistance. In addition, we reported that simulated experience method is an effective method to promote utilization of care recipient power by caregiver. The method encourages the caregiver to understand the ability of the care recipient⁵⁾. However, various dysfunctions lead to a need for care, and it is unclear that the simulated experience method might be effective to these

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dysfunctions.

It has been reported that cerebrovascular disorders, fractures, and falls commonly lead to a need for care in daily life⁶. Hemiplegia and limited range of motion (ROM) in these disorders are likely to be therapeutic problems in physical therapy⁷. It has been reported that, when focusing on the transfer motion, it is difficult for the hemiplegic patient to accelerate their center of mass (COM) forward at the stand up, which is a component of transfer⁸. In addition, a certain degree of ROM of the hip, knee, and ankle joints is required for the stand up⁹⁻¹¹. Clearly the transfer motion becomes difficult in people with severe hemiplegia or limited ROM of the joints.

We aimed to clarify, whether the simulated experience method is effective for improving caregivers' use of the ability of a person with hemiplegia or limited ROM in multiple joints during transfer assistance using the change in the load on the lower limbs of care recipient's as an index. That is, the purpose in this research was to add knowledge about dysfunction to which the simulated experience method could be applied.

PARTICIPANTS AND METHODS

In this study, we used the load on the lower limbs of the care recipient at the time of the buttocks leaving the seat used as the index of transfer ability¹². A measurement system consisting of two measurement devices, to quantify total floor reaction force and hip-floor reaction force, and force shoes, was used⁵. Each device is made of a stainless steel panel and load cells (LMB-A-2KN-P; Kyowa Electronic Instruments Co., Ltd., Tokyo, Japan). Information from the load cells of each device was taken into a PC at a sampling frequency of 100 Hz via a universal recorder (Kyowa Electronic Instruments Co., Ltd.), and was processed by Labview (National Instruments Japan Corporation, Tokyo, Japan). The accuracy of each device was confirmed by a floor reaction force meter (AMTI Japan Ltd., Kanagawa, Japan).

The total number of participants was 61 in this study. Many of participants comprised 60 nursing assistants working in a nursing home setting: 26 females and 4 males (n=30) were assigned to the study of pseudo-hemiplegia, and 27 females and 3 males (n=30) to the study of limited ROM in multiple joints. The average occupational experience of the participants was 10.4 ± 4.8 years for pseudo-hemiplegia and 8.9 ± 4.5 years for limited ROM in multiple joints. Participants of each study were divided into two groups: the control group and the simulated experience method group. Stratified randomization was applied based on occupational experience so that each group would comprise 15 participants. The average occupational experience of the control and simulated experience groups was 10.4 ± 4.9 years and 10.4 ± 4.7 years, respectively, in the pseudo-hemiplegia study, and 8.4 ± 3.6 years and 9.5 ± 5.2 years, respectively, in the limited-ROM-in-multiple-joints study.

The role of the care recipient was played by one healthy adult male (height, 176.5 cm; weight, 65.0 kg). For pseudo-hemiplegia, he was fitted with an elbow orthosis and an ankle foot orthosis (both from Howashi Co., Ltd., Kumamoto, Japan) on the right side to suppress the function of the right half of the body. Using the attached braces, his right elbow was fixed at 90° flexion, and his right ankle joint was placed at a fixed equinus position of -20° dorsiflexion. For limited ROM in multiple joints, hip flexion affecting activities of daily living and ankle dorsiflexion affecting stand-up motion were selected^{13, 14}. Therefore, he was fitted with a hip brace with a dial lock mechanism (Howashi Co., Ltd.) and an ankle foot orthosis (Howashi Co., Ltd.) on the right side; right hip flexion was limited from 110°, right ankle dorsiflexion limited from -20°, and left hip flexion limited from 90°. Before receiving transfer assistance from each caregiver participant, the mock care recipient was seated in a chair with a knee flexion angle of 90°, ankle joint flexion angle of 0°, and a center-to-center distance between both heels of 300 mm at a height of 410 mm. In this position, he was unable to stand on his own from the chair.

Next, caregivers were instructed to take as much advantage as possible of the care recipient's ability to help with the transfer, and performed the first transfer assistance by any means. Also, the placement of the wheelchair, with the foot support removed, was left to each participant. After the first transfer assistance, caregivers in the simulated experience method group were instructed by the physical therapist about the points of support. Caregivers in the simulated experience group then received advice regarding corrections in the direction and timing while performing transfer assistance to a physical therapist who imitated the care recipient.

Points of support were summarized by a physical therapist (7 years of clinical experience) based on the functional evaluations of these types of care recipients. There were four points in both cases: (1) The wheelchair with removed foot support was placed on the left side of the care recipient and at the closest position; (2) Before starting assistance, the caregiver induced the seated care recipient to move his left sole backward to make it easier to use left leg power, and to grasp the wheelchair arm support with his left hand; (3) Before starting assistance, the participant took a position to place his/her right foot in the back and left foot in the front, and then guided the caregiver to lean forward as much as possible by moving his or her center of gravity to the hind foot and then gave a signal to rise. It should also be noted that the tip of the right foot of the caregiver had to be positioned further behind the half of the left foot on the sagittal plane, but the scope of that positioning was optional; and (4) The trunk leaning of the caregiver was guided in the direction of his left foot. In the study of limited ROM in multiple joints, the following point was added: before the buttocks of the care recipient were to leave the chair, the caregiver pulled the upper body of the care recipient forward not upward¹².

After 3 minutes of intervention by the physical therapist, the simulated experience method group once again assisted transfer to the care recipient. In the control group, 3 minutes after the first transfer assistance trial, the caregivers assisted transfer to the care recipient for a second time. The level of loading on the care recipient's lower limbs when the buttocks left

the chair was examined: the time point at which the value of the reaction force of the buttocks was <9.8 N after the start of transfer assistance was taken as the time of the buttocks leaving the chair. The difference in the level of loading time on the care recipient's lower limbs between the second and first trials was calculated.

This study was conducted in agreement with the ethical principles of the Declaration of Helsinki and was approved by the Ethics Committee of Kyushu University of Nursing and Social Welfare (approval number: 28-005). The study was explained to the participants to obtain their consent to cooperate. IBM SPSS Statistics 22 (IBM Japan, Ltd., Tokyo, Japan) was used for statistical analysis, and the significance level was set at 5%. The differences between the groups were compared using an unpaired t-test.

RESULTS

The difference in the load on the lower limbs of the care recipient with pseudo-hemiplegia when his buttocks left the chair between the second measurement and the first was -5.9 ± 74.5 N for the control group and 107.9 ± 123.6 N for the simulated experience method group. Regarding the load on the lower limbs in the limited-ROM-in-multiple-joints study, the value of the difference between the second measurement and the first was -14.7 ± 64.7 N for the control group and 149.1 ± 132.4 N for the simulated experience method group.

For the pseudo-hemiplegia study, all participants set the wheelchair to the left of the care recipient for both the first and second rounds of transfer assistance. In the limited-ROM-in-multiple-joints study, only 12 participants of the control group and 10 participants of the simulated experience method group set the wheelchair to the left of the care recipient in two transfers. Three participants in the control group set the wheelchair to the right side of the care recipient in two transfers. Five caregivers in the simulated experience method group set the wheelchair on the right side for the first transfer assistance and on the left side for the second round; the load difference in this case was 104.9 ± 119.6 N. In the simulated experience method group, the load difference when the wheelchair was set on the left side of the care recipient at both the first and second transfers was 171.6 ± 138.3 N (Table 1).

DISCUSSION

We have already reported that simulated experience method is an effective method to promote utilization of care recipient power who had a limited range of motion in hip joint by caregiver⁵⁾. Results of this research suggest that hemiplegia and limited-ROM-in-multiple-joints are added as dysfunctions that can be applied to the simulated experience method in transfer assistance. Actually the simulated experience method promoted the participation of a care recipient with pseudo-hemiplegia or limited ROM in multiple joints to utilize their abilities during transfer assistance. In the stand-up motion, it is generally necessary to switch the forward movement of the COM to an upward movement, and a floor reaction force higher than the upright standing posture is applied to the lower limbs as the buttocks are leaving the chair¹⁵⁾. Therefore, when a care recipient's ability is utilized by the caregiver during a transfer motion, a sufficient load is applied to the feet of the care recipient when his buttocks leave the chair. Conversely, if the caregiver shifts to the upward movement of the care recipient's COM when the care recipient's forward movement of the COM is insufficient, the care recipient is not in a position to exert his power. In this situation, the caregiver is required to lift the weight of the care recipient to complete the transfer. Unfortunately, musculoskeletal disorders that occur in medical and welfare workers can be caused by handling tasks performed for patients or older-age residents¹⁶⁾.

One of the methods to move the COM forward at the time of stand-up is a strategy that moves the COM to above the foot by tilting the trunk forward before the buttocks leave the chair¹⁷⁾, and is often used in older people with dysfunction⁸⁾. The instructions given by the physical therapist in the simulated experience method group in this study induced a stand-up using the strategy described above, which was rationalized from the viewpoint of utilizing the power of the lower limbs of the care

Table 1. Load difference on the lower limbs of the care recipient between the second transfers and the first transfers

	Load difference on the lower limbs of the care recipient (Newtons)	
	Pseudo-hemiplegia	Limited ROM in multiple joints
Control group	-5.9 ± 74.5	-14.7 ± 64.7
Simulated experience method group	$107.9 \pm 123.6^*$	$149.1 \pm 132.4^*$

ROM: range of motion. Values are displayed as mean \pm standard deviation.

*Significant difference with the control group ($p < 0.05$).

All caregivers were instructed to take as much advantage as possible of the care recipient's ability to help with the transfer, and performed the first transfer assistance by any means. Caregivers in the simulated experience method group carried out the second transfer, after they received 3-minute intervention by the physical therapist. Caregivers in the control group carried out the second transfer after 3 minutes without the physical therapist's intervention.

recipient.

The fact that all of the participants in the hemiplegia study set up the wheelchair opposite the pseudo-hemiplegic side from the first transfer assistance suggested a widespread perception regarding the function of the non-paralyzed side among care workers. This result also suggested that the setting direction of the wheelchair did not affect the results of this study. It was expected that the difference in load would increase if the wheelchair position was changed from the right side to the left side of the care recipient in the transfer-of-limited-ROM in multiple joints study, but it was lower than expected. These results suggested that the cause of the increased load on the lower limbs of the care recipient was not only the wheelchair direction, but also the influence of the motion guidance method.

Thus, this study indicates that, for cases of hemiplegia or limited ROM in multiple joints, the abilities of caregivers can be improved using a simulated experience method. However, stroke in some patients can be complicated by sensory impairment or higher brain dysfunction, so it would not be effective for all patients. Likewise, if there is limited ROM in multiple joints, the degree and combination will be varied, so to make full use of the ability, it is necessary to exhaustively examine the situation before proposing an optimized approach to transfer assistance.

In this study, to unify the disability type, pseudo-hemiplegia and pseudo-limited ROM in multiple joints were artificially set using orthotic braces, which clarified that the use of a simulated experience method could promote transfer assistance utilizing the abilities of a care recipient with these conditions. Future development of this method will require more advanced research on patients with actual hemiplegia and limited ROM in multiple joints.

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Conflict of interest

The authors declare no competing interests.

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