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Original Article

Falls in the sitting position—Characteristics and efficacy of preventive measures—

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ABSTRACT
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Introduction: In the prevailing definition, falls in the standing position and falls in the sitting position with the buttocks touching the ground or floor are not distinguished from each other. In practice, however, the types of motion that lead to the fall differ between these two types of falls. The present study was undertaken to investigate the characteristics of individuals falling in the sitting position and to evaluate the efficacy of preventive measures taken with such characteristics considered.
Study 1: The characteristics of the individuals experiencing falls in the sitting position were investigated retrospectively. These patients tended to demonstrate retained cognitive function, and the fall often occurred when the individuals attempted to reach for an object at the bedside. On the basis of these findings, measures for prevention of falls (primarily patient education) were attempted.
Study 2: The frequency of falls before the preventive measures were established was compared with that after the measures. The frequency of falls in the standing position did not decrease after these measures, while the frequency of falls in the sitting position decreased to about one-fifth after the measures.
Discussion: The preventive measures taken were useful in preventing falls. In future, it may be necessary to extensively apply measures for preventing specific types of falls.
Key words: fall, sitting, fall-preventive measures

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Introduction

Falls among elderly people living in a local community are often caused by factors during walking such as stumbling, slipping, and being unaware of differences in level of the ground or floor [1–3]. On the other hand, factors responsible for falls among hospitalized patients are more diverse, ranging from those during walking to other factors such as getting onto a wheelchair, getting up from a bed, and voluntary training and rehabilitation. According to a survey conducted at a convalescent rehabilitation ward (hereafter, "convalescent ward"), the motions often leading to a fall were related to defecation (37.8%) and reaching for an object (12.7%), and the posture maintained at the time of the fall was the sitting position (including sitting on a wheelchair) in about 20% of the cases [4, 5]. Moreover, during clinical practice, falls onto the floor often occur when patients attempt to reach for an object while sitting on a bed or wheelchair. The types of motion leading to falls differ completely between falls in the active standing position (such as walking or getting onto a wheelchair) and falls in the sitting position with the buttocks in contact with the ground or floor.

In 1987, the Kellogg International Working Group defined a fall as "an event which results in a person coming to rest inadvertently on the group or other lower level and other than as a consequence of violent blow, loss of consciousness, sudden onset of paralysis, as in a stroke, or an epileptic seizure" [6]. In the Frailty and Injuries: Cooperative Studies of Intervention Techniques Study, a fall was defined as "unintentionally coming to rest on the ground, floor, or other lower level place" [7]. In these definitions, falls that occurred in the standing position were treated similarly as falls

that occurred in the sitting position. To our knowledge, there is no published report distinguishing between these two types of falls. In addition, because the types of motion that lead to these two types of falls differ, the individuals who experience a fall in the sitting position may have unique characteristics and it is therefore necessary to design preventive measures after taking such characteristics into account. The present study was undertaken to investigate the characteristics of patients who experienced falls in the sitting position during their stay at our hospital's convalescent ward and to establish preventive measures with such characteristics taken into account, followed by an evaluation of the efficacy of such measures.

Study 1: Characteristics of patients who experienced falls in the sitting position

1. Objectives

Study 1 aimed to investigate the characteristics and situations related to the patients experiencing falls in the sitting position during their stay at our hospital's convalescent ward and to devise fall-preventive measures on the basis of the survey results.

2. Subjects and methods

Our hospital is a rehabilitation hospital that possesses 54 convalescent beds and provides rehabilitation services throughout the year (as of July 2014).

The study included 23 patients who experienced a fall in the sitting position extracted from among all patients staying at our hospital's convalescent ward during the 3-year period from August 2010 to July 2013. Figure 1 illustrates the method of inclusion. On the basis of the medical records, of 702 patients staying at the ward, 117 (16.7%) experienced a fall, and the incidence report data indicated that 27 patients had a fall in the sitting position. Of these 27 patients, 4 experienced multiple falls (including a fall in the standing position), and therefore, the remaining 23 patients were selected for the study. The definition of fall proposed by the Kellogg International Working Group was adopted in this study [6]. Falls in the sitting position were defined as falls with the buttocks kept in contact with the ground or floor. All the subjects provided consent to the utilization of their data for research purposes upon admission to our hospital.

In addition to the diagnosis, age, sex, and level of rest required, parameters and factors of physical and cognitive functions reportedly associated with falling were investigated retrospectively using the medical records of individual subjects. With reference to the previously reported studies on the characteristics of inpatients who have experienced falls [8−15], the following were investigated: (1) physical function — presence/absence of central paralysis, presence/absence of sensory disorder, means for movement, capability of movement, dislocation, total motor score of the functional independence measure (FIM) upon admission and at the time of the fall (M-FIM); and (2) cognitive function — Hasegawa Dementia Scale Revised (HDS-R) score and the total FIM cognitive score (C-FIM). Furthermore, the situations related to the fall were assessed on the basis of a retrospective investigation of the incident reports about the place of fall, presence/absence of assistance providers, motions at the time of fall, and presence/absence of deviation from the required rest level.

At our hospital, the rest level is divided into four categories: (1) complete bed rest, (2) sitting permitted, (3) moving within the ward permitted, and (4) moving within the hospital permitted. Requirements added to

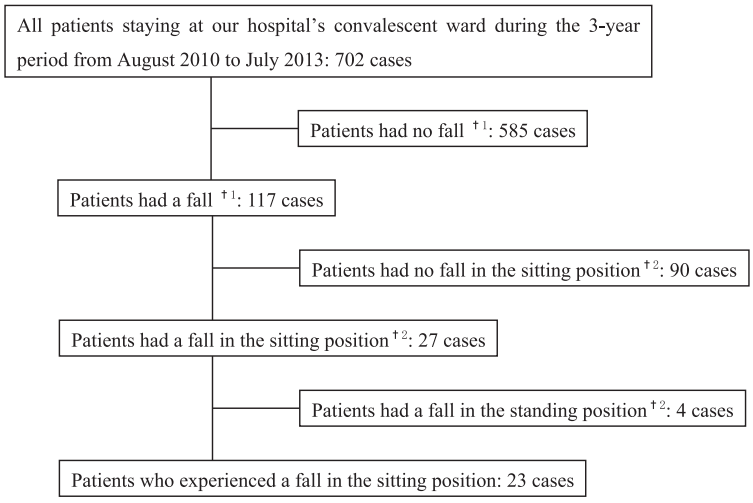

Figure 1. Method of inclusion.

some of these categories are the ability to use the nurse call and lack of dangerous behavior (category 2), ability to move within the ward safely at any time of the day (category 3), and ability to use the elevator and move greater distances (category 4). The rest level for individual patients is finally decided by the attending physician after discussion at the multi-disciplinary conference held every morning. This method is the same for all patients and is adopted when the rest level is changed. Deviation from the preset rest level was defined as when the behaviors involved more effort than that at the preset rest level (e.g., unassisted walking by a patient instructed to maintain complete bed rest). After the rest level was decided, nurses assessed the falls on the ground or floor and from a height for each patient with our hospital's unique assessment sheet. On the basis of the results of this assessment, the bed location was decided and devices/tools such as a sensor mat were arranged.

The data collected were stored in a linkable anonymous manner, with care taken to protect the patients' privacy. The study design was approved by the Showa University Fujigaoka Hospital Clinical Study Review Committee (Acceptance No.: 2014073).

3. Results

The rest level at the time of falling in the sitting position was complete bed rest in 2 cases, sitting permitted in 16 cases, movement within the ward permitted in 3 cases, and movement within the hospital permitted in 2 cases. Thus, many of the patients who experienced a fall in the sitting position were unable to move without assistance although they practiced safe behavior and were able to sit. In the analysis of the physical functions reportedly associated with falling, central paralysis was observed in 19/23 patients (82.6%), sensory disorder in 17/23 patients (73.9%), use of a wheelchair for dislocation in 21/23 patients (91.3%), and assistance for movement required in 18/23 patients (78.2%). The M-FIM score was 46/91 upon admission and 62/91 at the time of the fall. In the evaluation of cognitive function, the HDS-R score was $\geq$21 in 17/23 patients (73.9%), and the C-FIM score was 30/35 upon admission and 32/35 at the time of the fall (Table 1).

A total of 31 falls occurred while in the sitting position (1 fall in 24 patients, 2 falls in 2 patients, and 3 falls in 1 patient). Furthermore, 26/31 falls (83.9%) occurred at the bedside, and 25/31 falls (80.6%) occurred in the absence of an assistance provider. The motions leading to the fall were reaching for an object on the floor (12 falls), reaching for an object on the bed (8 falls), reaching for an object on the bed table (5 falls), reaching for an object in the refrigerator (3 falls), and moving/changing the position on the wheelchair (3 falls). Thus, reaching for an object accounted for more than 90% of falls. The motions that led to a fall were within the rest level instructed by

Table 1. Characteristics of patients who experienced falls in the sitting position.

Patients who experienced falls in the sitting position (n=23)		
Diagnosis	Cerebral infarction	10
	Cerebral hemorrhage	6
	Brain tumor	1
	Spinal cord injury	5
	Leg fracture	1
Age (years)	—	70.5 ± 11.5
Sex	Male/Female	14/9
Level of rest	Complete bed rest	2
	Sitting permitted	16
	Moving within ward permitted	3
	Moving within hospital permitted	2
Central paralysis	Present/Absent	19/4
Sensory disorder	Present/Absent	17/6
Means of dislocation	Walk/Wheelchair	2/21
Moving capability	Unassisted/Assisted	5/18
HDS-R score	≥21	17
	<21	4
	Unknown	2
M-FIM score†	Upon admission	46 (31–62)
	Upon falling	62 (37–72)
C-FIM score†	Upon admission	30 (25–33)
	Upon falling	32 (25–35)

† Median (inter-quartile range)

Table 2. Situations upon falling in the sitting position.

Falls in the sitting position (n=31)		
Place	Bedside	26
	Toilet	1
	Temporary discharge home	4
Assistance provider	Present/Absent	6/25
Motion upon falling	Reaching for an object on the floor	12
	Reaching for an object on the bed	8
	Reaching for an object on the bed table	5
	Reaching for an object in the refrigerator	3
	Moving/changing sitting position on wheelchair	3
Rest level	Complying/Deviated	28/3

the physician in 28/31 patients (90.3%) (Table 2).

4. Analysis and preventive measure

These results indicate that the patients who experienced falls in the sitting position had problems with physical function but had retained cognitive function, which differs from the characteristics reported in previous studies of hospitalized patients experiencing falls. Furthermore, falls at the bedside tended to occur while the patient was trying to reach for an object, even though the motion was within the rest level instructed by the physician. On the basis of these results, we devised certain preventive measures, focusing on education of patients about the risk of falls at the bedside. These measures include: (1) providing guidance on the motions practiced during the sitting position, which might increase one's risk of a fall at the bedside, (2) providing a learning course for all patients periodically to disseminate knowledge about prevention of falls in the sitting position, and (3) presenting at the bedside the level of independence required for reaching for an object while sitting on a wheelchair or on the bed (Table 3).

Study 2: Efficacy of the measures taken to prevent falls in the sitting position

1. Objectives

Study 2 aimed to establish measures for prevention of falls in the sitting position and to evaluate their efficacy by comparing the frequency of falls before and after these measures.

2. Subjects and methods

Of the 912 patients staying at our hospital's convalescent ward during the 4-year period from

Table 3. Measures for preventing falls in the sitting position.

Measure	Coverage	Timing	Description
Bedside motion guidance	All patients	Irregularly (mandatory when rest level is changed)	The therapist in charge provides bedside guidance on motions in the sitting position that increase the risk of falls, taking into account the results of Study 1.
Learning course for patients	All patients (excluding those experiencing difficulty while sitting or remaining seated on the wheelchair)	Once every 3 months	The therapist serves as the lecturer, providing a 30-minute lecture on measures for preventing falls in the sitting position.
Presenting the independence level needed for object-reaching motions	Patients at or above the rest level "sitting permitted"	When rest level is changed	Similar to the conventional procedure of establishing the rest level for individual patients, the level of independence required for individual actions (reaching for an object on the floor, bed, bed table, or refrigerator) is decided. This independence level is presented on paper at the bedside. The therapist in charge reviews the paper every time the independence level is changed.

Table 4. Patient information during the countermeasure period and the non-countermeasure period.

	Non-countermeasure period (Aug 2010 to Jul 2013)			Countermeasure period (Aug 2013 to Jul 2014)
Period	Aug 2010 to Jul 2011	Aug 2011 to Jul 2012	Aug 2012 to Jul 2013	Aug 2013 to Jul 2014
Age (years)	70.0 ± 15.1	69.8 ± 14.6	69.2 ± 14.5	70.2 ± 13.9
Newly admitted patients	254	235	213	210
Sex, M/F	149/105	134/101	129/84	101/109
Patients with cerebrovascular disease (%)	74.4	77.0	75.6	70.5

August 2010 to July 2014, 150 patients (16.4%) whose medical records included the incidence of falls during their stay at the ward were enrolled in this study. Upon admission, all of these patients provided consent to the utilization of their data for research purposes. The number of falls in the standing position and the number of falls in the sitting position were investigated retrospectively for each of the two periods: (1) August 2010 to July 2013 (the period without measures taken; "the non-preventive countermeasure period") and (2) August 2013 to July 2014 (the period with measures taken; "the preventive countermeasure period"). There was no change in the nurse allocation standards for the ward between the non-preventive countermeasure period and the preventive countermeasure period. No evident difference was observed between the two periods in terms of the patients' age, number of new ward admissions, sex, or percentage of patients with cerebrovascular disease (Table 4).

3. Results

The mean annual number of falls that occurred in the standing position was 39.7 during the non-preventive countermeasure period (45, 35, and 39, respectively) and 44 during the preventive countermeasure period, showing no decrease from the non-preventive countermeasure period (Fig. 2). The mean annual number of falls in the sitting position was 10.3 during the non-preventive countermeasure period (11, 10, and 10) and 2 during the preventive measure period, which was a decrease to one-fifth (Fig. 3). Two falls in the sitting position occurred when the patient attempted to reach for an object while violating the preset rest level or to change the sitting position on the wheelchair. This type of fall often took place during the non-preventive measure period. Attempts to reach for an object while complying with the preset rest level never resulted in a fall.

Discussion

1. Characteristics of patients who experienced falls in the sitting position

Investigation of the characteristics of patients who experienced falls in the sitting position revealed that the patients often had central paralysis or a sensory disorder. Furthermore, these patients tended to require assistance for movement, often using a wheelchair. The M-FIM score upon admission was 46, within the range of 35−58 reported for individuals experiencing falls in previous studies [12−14]. These findings suggest that, similar to the characteristics reported previously, falls in the sitting position were associated with the presence of problems with physical function. On the other hand, intellectual function tended to be preserved, with the HDS-R score being ≥21 in more than 70% of the patients experiencing falls. The C-FIM score upon admission was 30, indicating a

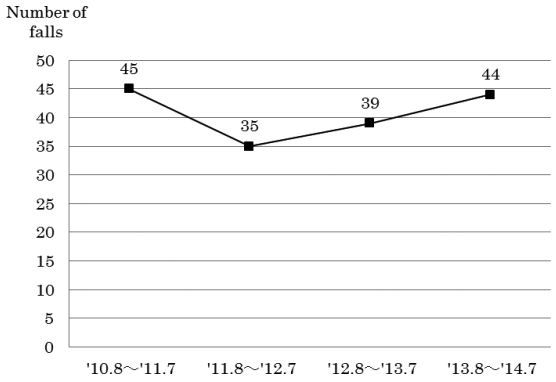

Figure 2. Falls in the standing position.

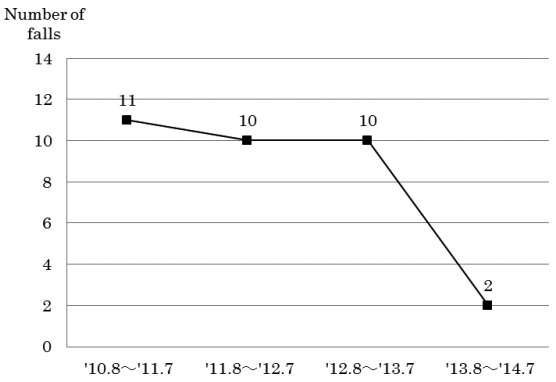

Figure 3. Falls in the sitting position.

higher independence level than in previous reports (C-FIM 19−27) [12−15]. Furthermore, more than 90% of these patients complied with the rest level instructed by the physician. Thus, the patients who experienced falls were considered to have retained cognitive function (problem-resolving capability). Many investigators including Nyberg et al. demonstrated an association between falls and cognitive dysfunction [8−15]. Thus, one can speculate that preserved cognitive function is a major characteristic of patients with falls in the sitting position.

Furthermore, several falls occurred when the patient attempted to reach for an object at the bedside while complying with the instructed rest level. Factors probably underlying this fact are: (1) lack of sufficient knowledge by the patient about the risk of falling in the sitting position, and (2) inadequacy of the four-level rest instruction system adopted at our hospital. In light of these findings, it seems necessary to take the following measures for prevention of falls in the sitting position: (1) providing knowledge about the risk of falls in the sitting position to patients, and (2) permitting object reaching in addition to the current rest level instructions.

2. Efficacy of measures taken for prevention of falls in the sitting position

After the above-mentioned preventive measures were taken, the frequency of falls in the sitting position decreased to about one-fifth. Moreover, the falls that occurred while attempting to reach for an object and complying with the rest level instructed decreased to 0. These results suggest that the preventive measures were effective to some extent.

Measures conventionally taken for prevention of falls at the convalescent ward include direct approaches such as informing the risk of falls to patients and their family members through interview and leaflets. Some of the other measures include identification of high-risk patients with an assessment sheet, introduction of a checklist, unification of the monitoring and assisting methods, arrangement of the environment, recurrence-preventive measures, and near-miss reports [5]. Kakuda et al. described the necessity of mutual understanding and confirmation of important precautions through concrete instructions about fall prevention during the orientation on daily living during the patients' hospital stay [16]. Because the patients who experienced falls in the sitting position tended to have preserved cognitive function, one can assume that implementation of measures similar to direct approaches (e.g., guidance regarding the motions that increase the risk of falls in the sitting position) was effective in this study. The measures that were established include bedside motion guidance, provision of learning courses, and presentation of the independence level; these were not stressful for patients, unlike continuous monitoring, suppression, and frequent room visits. These measures seem to be applicable to various patients, even when ethical viewpoints are taken into account. However, in the present study, the frequency of falls in the standing position did not decrease. This result may be associated with the following factors: (1) the measures taken were solely for preventing falls in the sitting position; and (2) manifestation of the effects of preventive measures at our convalescent ward was limited because the incidence of falls in this ward (16.4%) was lower than that at other facilities [11−15] owing to a clear definition of the rest level decision process and thorough implementation of risk-based countermeasures using the assessment sheet at our ward. Going forward, it may be necessary to predict likely falls in light of the characteristics of individual patients and to extensively apply measures for prevention of specific types of falls.

3. Limitations

This study involves the following limitations. First, the study was retrospective in nature, had unreliable information, and lacked any dynamic analyses at the time of the fall. Second, the study was conducted at a single facility, and thus has poor external validity. Third, the sample size was small and the period after implementation of the preventive measures was short. In future, it is necessary to conduct a prospective evaluation of the efficacy of the preventive measures, using multicenter surveys and long-term efficacy evaluation, accompanied by a dynamic analysis of falls in the sitting position. Such studies would clarify the problems at more detailed functional levels.

Conclusions

The characteristics of patients who experienced falls in the sitting position were retrospectively investigated among patients staying at the convalescent ward of our hospital, then preventive measures were devised and implemented and their efficacy was evaluated. Patients who experienced falls in the sitting position tended to have retained cognitive function and to experience falls when attempting to reach for an object within the preset rest level. In light of these findings, we devised certain countermeasures, including providing knowledge about the risk of falls in the sitting position to the patients. After implementation of the measures, the frequency of falls in the sitting position decreased to about one-fifth. In future, it may be necessary to predict falls likely to occur in view of the characteristics of individual patients and to establish extensive countermeasures.

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