

The Architectural Factors in Continuity of Living for the Elderly After Falls and Fractures

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Abstract

Falls and fractures are a serious problem for the elderly and can change their lifestyles drastically. To continue living in their own homes after falls and fractures, it is important to understand how architectural environments must be changed after falls and fractures. To examine these changes, two interviews were conducted: bedside interviews at the University of Tokyo Hospital and home-visit interviews. For both sets of interviews, seven patients (seven female and one male; ages 86.6 ± 5.6) were surveyed. Six patients could return to their own homes, and one had died. In the six cases, four patients renovated their homes after falls; however, one did not need to do renovation because she had done so before the fall. These cases of renovation included the installation of handrails, elimination of steps, changing floor materials, and so on. However, it was also shown that some renovation would be an obstacle rather than help in living alone. The families' support had little change before and after falls, and it was clarified that this family support included advice about renovation even though the family did not live with the patients. These results indicate what kind of advice from architectural experts is required for the patients when they go back home from the hospital after falls and fractures.

Keywords: Falls, Fracture, Elderly, Renovation of Homes, Interviews

1. Introduction

In 2013, the Ministry of Health, Labour and Welfare reported that over 80% of elderly Japanese who were born between 1947 and 1949 would like to continue living in their own homes (Ministry of Health, Labour and Welfare, 2013). However, there are many factors that prevent them from continuing to do so in their old age; falls and fractures are one of these factors. Falls and fractures could change the lifestyles of the elderly and could cause them to be hospitalized or bedridden. Femoral fractures are of particular importance and over 90% of these are caused by falls (Otaka, 2015). Falls happen to 10%-30% of the elderly in a year (Yamada, 2014; Kawakami, 2006) and once they fall, half of them will fall again within a year (Rubenstein, 2002). The number of elderly in Japan is increasing year by year and, currently, 27.3% of the population are over 65 years old (Ministry of Health, Labour and Welfare, 2017); therefore, the total number of falls

will increase in the future.

In the architectural field in Japan, many studies exist that are related to where and how the elderly fall in healthcare facilities or homes (Suda, 2004; Imaeda, 2017), but how the environments change after the falls and fractures is unknown. Studies in the field of physiotherapy has examined how patients who sustained fractures during falls could or could not go back to their homes (Karasawa, 2008; Shimamura, 2013), but these hardly mentioned any change to architectural environments. Furthermore, the renovation of homes requires significant investment. This study aims to clarify how architectural factors contributed to the continuity of living for elderly people who have experienced falls and fractures through the following three investigations of changes before and after falls. First, research was conducted on the physical and mental changes of elderly people who experienced falls and fractures. Second, architectural changes such as the renovation of homes where people could continue to live after accidents were noted. Third, research was conducted on how those architectural factors were related to the families' support, which was also important for the patients' continuity of living.

2. Methods

Patients who entered the University of Tokyo Hospital after they sustained femoral fractures were targeted as the subjects of this study in order to examine changes before and after falls. The target patients were over 60 years old and entered the hospital from September 2016 to February 2018. Two interviews were conducted for these patients: bedside interviews and home-visit interviews.

2.1 Bedside Interviews

Bedside interviews were conducted at the University of Tokyo Hospital. Patients were asked about their injuries and whether they fell or not was confirmed using a fixed definition of falls (**Table 1**, Imaeda, 2017) and fall models (**Fig. 1**, Imaeda, 2017). The physical conditions before falls were tested using GLFS-25 (Seichi, 2012). Fall situations (e.g., place, time, what to do at that time, etc.) and the living environment (e.g., living alone or with families, type of house, etc.) were assessed after patients entered the hospital.

Table 1 Definition of Falls

Fall / Fall down	Definition
Fall	A fall is an event which results in a person coming to rest on a lower level under the hip against their will, although an injury may or may not occur.
Fall down	A fall down is an event which results in a person coming to rest at a lower level under the hip against their will, although an injury may or may not occur. The body does not make contact with anything during the process of this event.



Fig. 1 Definition of Falls - Fall Model

2.2 Home-Visit Interviews

Home-visit interviews on the changes of lifestyles, physical conditions, and architectural changes were performed at patients' homes 9-12 months after they fell. The physical conditions were also tested using GLFS-25 and changes to environmental factors (e.g., living environment, renovation of homes, etc.) were inquired or measured (**Table 2**). If possible, a plan of their homes and pictures were taken.

3. Results

Thirty-three bedside interviews were conducted from September 2016 to February 2018 (**Table 3**) and all of them sustained fractures due to falls. Originally, 48 patients were introduced to the hospital, but interviews for 15 patients were not conducted for the reasons shown in **Table 4**. The most common reason was a sudden movement of patients to other hospitals.

Table 3 Basic Information of Patients

Age (Mean±SD)	83.5±7.1
Generation	60-70 71-80 81-90 91-
Female / Male	25 / 8
Terms of Hospitalization	26.4±7.4
Terms from Entering the Hospital to Operation	3.8±2.6
Live Alone / Live with Families / Others	9 / 23 / 1
Detached House / Apartment / Others	12 / 20 / 1
Move to Another Hospital / Going Back to Home directly	30 / 3

Table 4 Reasons Interviews Were Not Conducted

Move to Hospital of Rehabilitation suddenly	6
Patient's Age was under 65	2
Patient had Serious Dementia	2
Patient Got Infections	2
Others	3

Table 2 Contents of Home-Visit Interviews

Contents	Examples	List of Investigation	Methods
Influence by falls and fractures	Hard	Elimination of step, Installation of handrail, Not to use stairs, Changing the lighting etc.	Drawing the plan, Shooting photos
	Hard	When or how those hard measures were done	Measurements
	Soft	Temporary Refraining to go outside, Changing the lifestyle or action, etc.	List of date and contents
	Soft	Temporary Refraining to go outside, Changing the lifestyle or action, etc.	Interview
Efforts for fall	Soft	Temporary Refraining to go outside, Changing the lifestyle or action, etc.	List of contents
Measures to continue to live in their own house	Hard	Addition to above Hard & Change of the Family's support, Starting the welfare service or to live with family, Change of the method in Shopping etc.	Contents of repair of house in the future, Issues in Life
			Measurements & Interview

Next, patients who agreed to home-visit interviews were reached by telephone after they could go back to home. Eight cases (7 female and 1 male; ages 86.6 ± 5.6) were investigated. In these 8 cases, 2 cases were for the same patient because she broke her bone twice and entered the University of Tokyo Hospital again during the research term. The average term from fall to going back home was 75 days. For 6 interviews, the patients' family cooperated with this research and family interviews were also conducted at the same time, because they sometimes had better information than the patients themselves. The results are shown in **Table 5**.

3.1. Physical and Mental Changes of Patients

Of the 7 patients, 6 patients could continue to live in their own homes, and one patient was deceased during the research term. One female patient sustained two fractures. For the bedside interviews, 3 patients had a history of dementia or references to dementia in their clinical charts (Nos. 5, 6, and 7 in **Table 5**). During the home-visit interviews one of those 3 patients had died (No. 5); however, the other 2 patients could continue to live in their own homes and were received by their families. In the case of No. 7, the patient started to use a walker after the second fall. For the other 4 patients, one patient started to receive regular outpatient treatment for dementia after the falls (No. 4). There was one case that a patient's negative thinking had influenced her actions in terms of going outside (No. 2). Although there were changes in GLFS-25 scores (**Table 5**), the rest of the patients had no physical problems or changes to their mental conditions during the home-visit interviews.

3.2. Changes to Architectural Environments

Four patients had renovated their homes after falls (Nos. 3, 4, 6, and 7); however, one of the others did not need to conduct renovation because she had done so before the fall (No. 1). The rest of the patients did not renovate their homes after the falls (Nos. 2 and 5).

3.2.1. No. 3

In this case, the residence had several handrails when the patient fell mainly for the sake of her husband. However, some new handrails were added after she went back to home (**Fig. 2**). Originally, she had many diseases, thus she had moved the bed to the living room before she fell.

3.2.2. No. 4

This patient had dementia after she went back home, but it was not clear if the dementia was related to her fall. She lived alone before she fell and this did not change. Her daughter and son came to her house frequently and they had an important role in the renovation of her house, which was done after she fell and completely change the house (**Figs. 3, and 4**). In particular, her daughter lived far from her house (it took 90 minutes by train) and she stayed 2 or 3 days every week. She referred to the renovation during the bedside interview.

There were much renovation in the patient's house; however, some renovation confused her such as the new washing machine and the new kitchen. The operation of these appliances changed from what she was used to; therefore, due to her dementia, sometimes her daughter helped through telephone. In addition, a new veranda, intended for drying laundry, was not used. Instead, the patient used the bathroom and a dry heater for that purpose.

Table 5 Results of Architectural Changes Between Before and After Falls

No.	Sex	Ages at Bedside Interviews	Dementia	GLFS-25 Before Falls	GLFS-25 After Falls	Living Type	Type of House	Fall Place	Repair of House Before Falls (A)	Contents of Repair (A)	For Whom	Repair of House After Falls (B)	Contents of Repair (B)	Who Decided to Repair Mainly	Moving
1	F	92	No	28	41	Live Alone	Apartment	Bedroom of Patient's House	Yes	Handrail Beside Entrance Hall, Bathroom, Elimination of Steps Between Living Room and Corridor, Installation of Elevator of Apartment Building	For Patient	-	-	-	No
2	F	85	No	3	1	Live Alone	Apartment	Restaurant	No	-	-	-	-	-	No
3	F	76	No	26	49	With Families	Apartment	On the Roads	Yes	Bathroom and Toilet (Installation of Handrails)	For Patient's Husband	Yes	Entrance Hall, Washroom and Living Room (Installation of Handrails)	Patients and Her Son (Living with Patient)	No
4	F	86	No (Bedside Interview) ↓ Yes (Home-Visit Interview)	41	15	Live Alone	Detached House	Corridor of Hospital	No	-	-	Yes	Change Material of Floor (Living and Bedroom), Installation of Handrail for Entrance, Change the Bathroom, Washroom and Kitchen, Change type of Toilet (From Japanese Style to Western Style), Elimination of Steps Out of Entrance, etc.	Patient's Son and Daughter (Not Living with Patient)	No
5	M	93	Yes	42	- (Dead)	With Families	Apartment	Corridor of Patient's House	No	-	-	-	-	-	No (Dead)
6	F	92	Yes	35 & 38	22	With Families	Detached House	On the Roads & Corridor of Patient's House	No	-	-	Yes	Extension of Toilet, Installation of Handrail for Toilet and Entrance	Patient's Daughter (Living with Patient)	No
7	F	83	Yes	10	38	With Families	Detached House	Bedroom of Patient's House	Yes	Toilet, Bathroom, Stairs and Entrance (Installation of Handrails)	For Patient's Husband	Yes	Change of Bedroom (From Japanese Style to Bed)	Patient's Husband, Son and Son's Wife (Living with Patient)	No

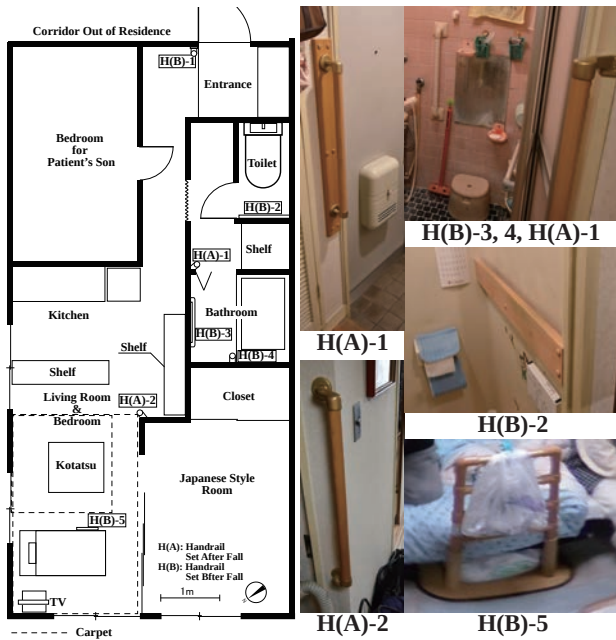


Fig. 2 No.3 Floor Plan and Handrails

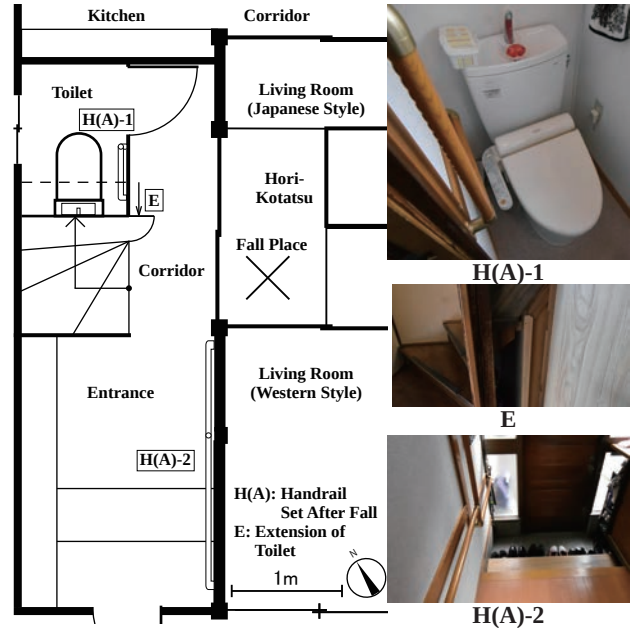


Fig. 5 No.6 Floor Plan and Repair



Fig. 3 Before(Left) & After(Right) Repair in No.4: Bathroom(Above), Living Room(Middle), Toilet(Bottom)

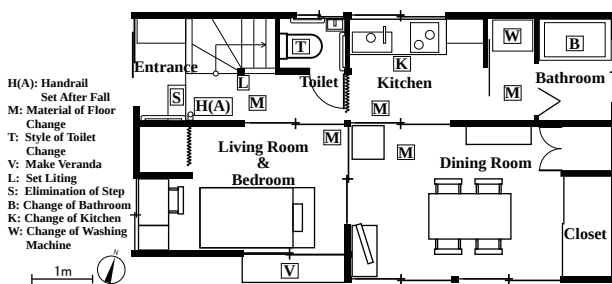


Fig. 4 No.4 Floor Plan and Handrails



Fig. 6 No.7 Bathroom, Toilet and Bedroom

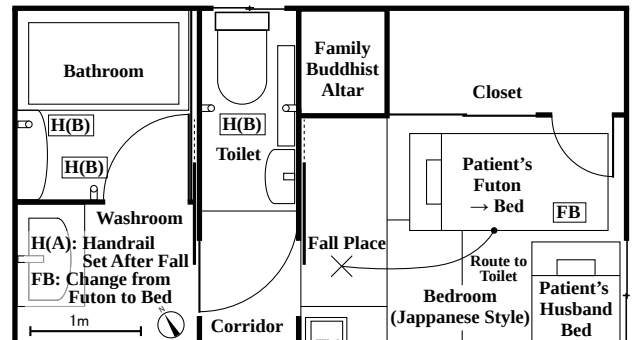


Fig. 7 No.7 Plan and Repair

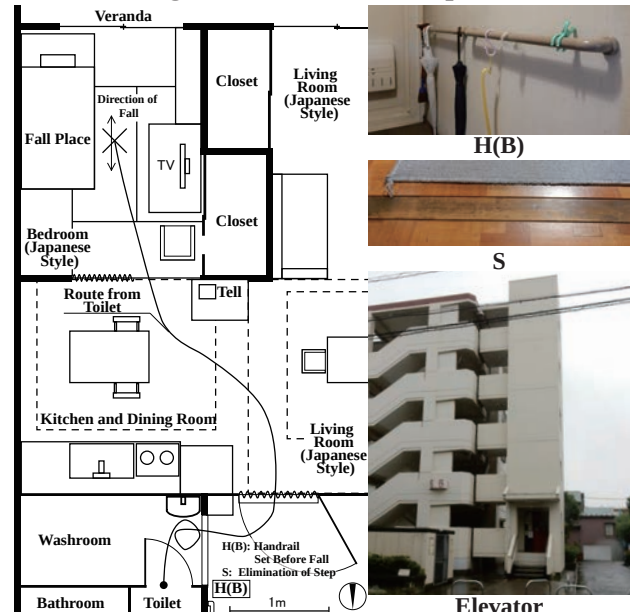


Fig. 8 No.1 Floor Plan and Repair

3.2.3. No. 6

The renovation in this case were also to add handrails. The patient's daughter and the daughter's family renovated the house because the patient already had dementia before she fell. She also expanded the toilet so that care in the toilet would become easier (Fig. 5).

3.2.4. No. 7

In this case, the patient's home was rebuilt in 2007. After rebuilding, handrails were installed in the entrance hall and stairs in 2013 for the patient's dementia. Handrails in the toilet and bathroom were installed in 2014 for her husband who had a cerebral infarction. After the patient fell, only the sleeping style was changed from the Japanese style to a bed (Figs. 6 and 7).

3.2.5. No. 1

During the home-visit interview, this patient did not renovate her house because she had already renovated it 10 years ago for her husband who had died long before she fell (Fig. 8). In addition to the renovation to her room, an elevator was installed for her apartment building which belonged to the Tokyo government.

This apartment was not wide and there were many things inside rooms, such as small shelves, desks, chairs, and so on. These helped her to walk by herself.

3.3 Family Support

During the bedside interviews, four patients lived with their families (Nos. 3, 5, 6, and 7) and two patients were supported by their daughters who visited often before they fell (Nos. 1 and 4). Only one patient had no support from her family (No. 2). These support systems did not change before and after the falls except in the case of No. 5 because the patient had died. In only one case, the number of visits from the patient's family increased slightly compared with before her fall (No. 1). In addition, this family support included advice on the renovation of homes.

4. Conclusion

From the results of Section 3, there were various types of renovation in the patients' homes, but it was clear in some cases that the renovation confused patients, especially in cases where patients had dementia. These types of renovation were an obstacle rather than help in living alone. On the other hand, there were some cases where previous renovation, which were not for falls and fractures, were used effectively. In these cases, only minimum renovation was necessary for falls and fractures.

This study showed how the elderly who experienced falls and fractures could continue to live in their own homes by renovating their homes from an architectural viewpoint. It also indicates what kind of advice will be required for the patients from

architectural experts when they go back home from the hospital after falls and fractures.

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