

## Effects of Intervention on Seating for Elderly Wheelchair Users

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### Abstract

The purpose of this paper is to report the results of intervention on the fit of seating for elderly wheelchair users who use foot propulsion. The elderly users, who lived in care facilities, were provided with improved wheelchairs for about two months while we investigated the seating posture, independent mobility, and degree of satisfaction during use.

The results of the investigation are as follows:

- (1) Seating pressure for the subjects who used the fitted wheelchair tended to decrease.
- (2) Independent mobility for the subjects using the fitted wheelchair tended to decrease. On the other hand, cases where the independent mobility improved were also observed.
- (3) Subjects were satisfied with the comfortable seating of the improved wheelchair. However, the small-sized elderly subjects were dissatisfied with the transfer, the meal action, and the fitted seat.

### Introduction

A more appropriate seating system will support and encourage the independence of elderly wheelchair users, and it will influence the quality of their lives.

Improvements in the life environment and care facilities for the elderly are proceeding because the elderly population is increasing. However, technical aid for an appropriate seating system for elderly wheelchair users is limited, and the quality of technology for appropriate seating systems for the elderly has been unimportant in care facilities, up to now. As a result, inappropriate wheelchairs for the elderly have been used in care facilities. Most importantly, elderly wheelchair users who used foot propulsion<sup>†1</sup> had to use wheelchairs with inappropriate seating and mobility because the seats of the existing wheelchairs were too high for them. The reason for this is that wheelchairs have often been standardized for arm propulsion because there have been few studies concerning elderly wheelchair users with the foot propulsion system.

Elderly people who use foot propulsion with inappropriate wheelchairs will increase the burden of their care. Furthermore, this problem will increase because the population of hemiplegic elderly is increasing. Consequently, a better seating system for elderly wheelchair users is necessary. In order to justify an appropriate evaluation of the seating system, investigation into the current seating systems and an objective evaluation was necessary.

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For the reasons mentioned above, we examined the following hypothesis based on the research results of the modular wheelchair<sup>†2</sup> to date. [1-5]

- (1) Elderly people using foot propulsion with a properly fitted wheelchair could improve their seating posture.
- (2) Elderly people using foot propulsion with a properly fitted wheelchair could improve their independent mobility.
- (3) Elderly people using foot propulsion with a properly fitted wheelchair could express satisfaction<sup>†3</sup> with the improved technology.

## Subjects and Methods

Subjects (Table 1):

- Five subjects over 65 years old, living in the care facilities: (1 male and 4 females)
- Elderly wheelchair users with the foot propulsion system who were willing to change their seating system for least 2 months.

Table 1 Characteristics of subjects:

Care Facility	Subject ID	Sex	Age	Weight (kg)	Arm Propulsion	Foot Propulsion	Kats Index	Berger Scale
A	A-1	F	86	49.0	right + left	right + left	C	2
	A-2	F	94	48.0	right + left	right + left	F	4
	A-3	F	80	49.0	right + left	right + left	G	4
B	B-1	M	87	40.0	right	right	G	4
	B-2	F	85	42.5	left	left	G	4

Kats Index : Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW : Studies of Illness in the Aged. *Journal of the American Medical Association* 185 : 914-919, 1963

Berger Scale: Berger EY : A System for Rating the Severity of Senility. *Journal of the American Geriatric Society* 28 : 234-236, 1980

Methods (Figure 1):

- Place: Two care facilities in Okayama Prefecture.
- Period: Between May and December 2001.
- Contents:
  - 1) Characteristics of subjects;
  - 2) Interviews with staff and subjects;
  - 3) Evaluation of seating and mobility;
    - I . Procedures for evaluation of seating and mobility:
      - ① We measured seat pressure and the mobility of the subjects using existing wheelchairs.
      - ② We took their physical measurements, and prepared new wheelchairs on the basis of this data.
      - ③ After they used the fitted wheelchairs for 1 week, we readjusted it.
      - ④ From the time of the readjustment, to about 3 weeks later, we measured pressure and mobility.
      - ⑤ Furthermore, about 3 weeks after that, we measured pressure and mobility again.

## II . Procedures for measuring seating and mobility:

- ① The staff of the care facility transferred the subject to the wheelchair.
- ② The staff of the care facility checked the seating posture of the subject.
- ③ While the subject moved from stationary state to a distance of 2M, we measured the movement time. Simultaneously, while the subject moved from a stationary state to 2M and stopped again, survey staff measured the pressure on the seat and the back in 5 frames/second (Measuring apparatus: Force Sensitive Applications, Takano). Furthermore, as for the interpretation of our seating pressure investigation results, we paid attention to the relative value based on the results of preceding research<sup>†4</sup>.

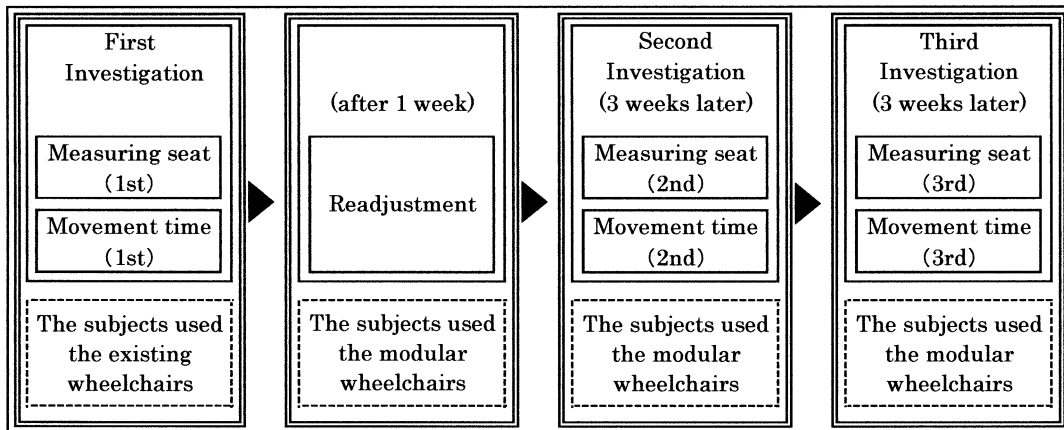


Fig. 1 Methods of investigation

## Results

(1) Pressure on the seat and the back: The investigation results for seating pressures are shown in Figures 2-4. The total contact area increased relatively with the changes in the wheelchair seating, though only for “A-2” it decreased during the third investigation (Figure 2). From the influence that the areas which supported posture increased, the pressure of neighborhood of the sacrum and ischial-tuberosity showed a tendency to decrease (Figure3), and the total average pressure showed a tendency to decrease, as well (Figure 4).

(2) The times for independent mobility for a distance of 2M: Investigation results for the movement time are shown in Figure 5. That the total seating contact area increased on the other hand, was connected with a decrease in the degree of freedom for that using foot propulsion. Therefore, a trend to decrease the ability for independent mobility of the wheelchair was observed, and the movement time for the wheelchair became relatively longer. On the other hand, during the first investigation, independent mobility for “B-1” was impossible because the seating was unstable. However, more independent mobility became possible after the second investigation because of adjustment in the wheelchair and seating. Also, independent mobility for “A-2” improved relatively, although her movement time during the third investigation was longer because of a physical condition, which was troublesome.

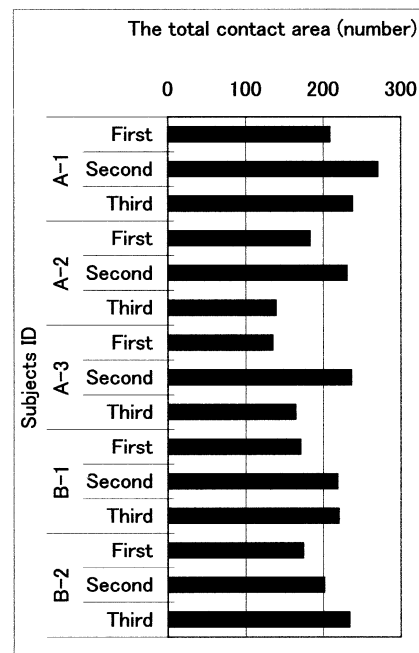


Fig. 2 Results of the total contact area (seat + back)

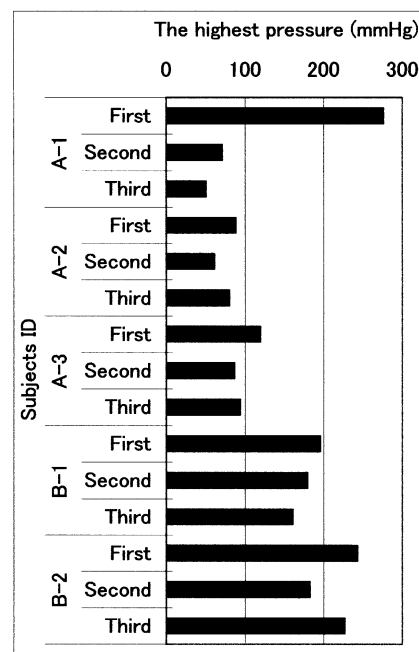


Fig. 3 Results of the highest pressure (seat + back)

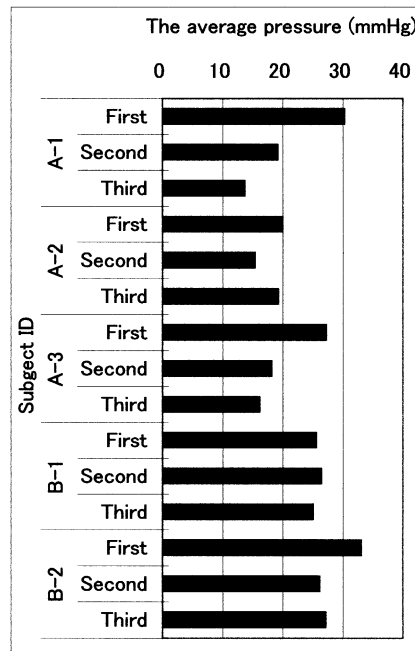


Fig. 4 Results of the average pressure (seat + back)

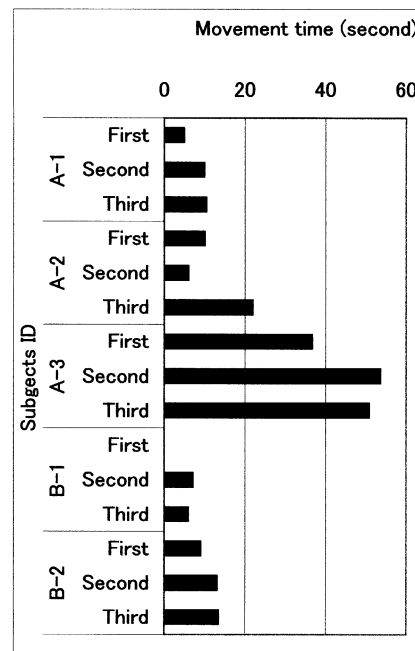


Fig. 5 Results of the times for independent mobility for a distance of 2M

## Discussion

It seemed that the elderly were threatened by changes in the wheelchairs and seating. This result trend was similar to preceding research results. [6] When our survey began, although the posture support of the existing wheelchair was inappropriate and uncomfortable, most of the elderly subjects were hesitant to change their existing wheelchairs and seating. They met with staff several times. After they understood that their opinions and desires were being respected, they were willing to try improvements in the wheelchair design. When wheelchairs for the elderly are exchanged for new ones from the familiar ones, we must consider the attachment of the elderly to the one with which they are familiar.

The subjects who used a fitted wheelchair tended to decrease pressure on the seat, and the independent mobility of the subjects who used a fitted wheelchair tended to decrease. On the other hand, cases where the independent mobility also improved were observed. Foot-floor contact improves the independent mobility of the wheelchair, and the foot-floor contact is a basic posture for support of the chair. Therefore, the seat height for the wheelchair was adjusted so that they reached the floor sufficiently. With the changes in the wheelchairs and seating, that total contact area was increased. On the other hand, this was also connected with a decrease in the degree of freedom of movement using foot propulsion. The subjects were satisfied with the more comfortable seating, although it seemed that the experience of their existing wheelchairs made independent mobility difficult. However, they would request the development of a seating system that has both a comfortable seat and easier independent mobility.

Contrary to our hypothesis, the small-sized subjects were not satisfied with the following points, because the existing wheelchairs were too big for elderly people with small body structure.

(1) The transfer between their wheelchair and the bed became difficult:

It seemed that the familiarity with their existing wheelchairs made the transfer difficult using the new wheelchair. Because small elderly people used wheelchairs with a low seat, the difference in the height between the bed and wheelchair was noticed. If a bed with a height adjustment function is used, this problem of the transfer will be solved. Further research on the efficient transfer of the elderly would clarify the most efficient height of the bed and the wheelchair.

(2) Their meal action became difficult:

It seemed that the familiarity with their existing wheelchairs made the meal action difficult using the new wheelchair. Because small elderly people used wheelchairs with a low seat, the difference in the height between the dining table and wheelchair was noticed. Furthermore, a table for 4 people has a tendency to be used in care facilities, and persons want to sit down at the same table with other friendly persons. To make a pleasant and independent meal possible, their table should be prepared and adjusted individually. If a dining table with a height adjustment function is used, this problem of meal action will be solved. Additionally, further research on meal action for the elderly would clarify the needed height of the dining table relative to the wheelchair.

(3) They felt the fitted seat was narrow:

Although subjects were provided with appropriate posture support and comfort, they tended to assert that a wide seat was better. The wheelchairs in which they sat have been designed for a male with a standard body size. Because the posture support of the existing wheelchair was inappropriate and the seat too wide, small elderly people were provided with a wheelchair with a fitted seat. Furthermore, the room available in the wide seat on the existing wheelchairs had been used to keep valuables and life articles. It was important to the subjects that they be able to continue to keep their valuables somewhere in the

wheelchair. This point is an unresolved problem. As for the problem of the difference in the width of the wheelchair needed to keep a suitable posture and storage, we will need more investigation to resolve this issue.

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#### Notes (†)

1. The person moves a wheelchair using the foot.
2. The wheelchair has an adjustment function. For example, the seat height, the seat angle, the wheel position and so on, which can be adjusted.
3. We investigated a difference in the degree of satisfaction when subjects used the existing wheelchair and the improved wheelchair.
4. Because seat pressure couldn't be used as an absolute value, we used it as an index of the individual relative evaluation.

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