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# Development of an assessment tool for matching of assistive technology devices for meal support: validity and reliability study

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## Abstract

This study was performed to develop an assessment tool for matching of meal support assistive technology devices (ATDs), and to verify the validity and reliability of this tool. To determine items for the matching assessment tool, a questionnaire survey was conducted among 40 specialists regarding items that they considered the most important for evaluating the matching of ATDs. The following 10 items were extracted: “simplicity of grasp,” “operability of the ATD,” “range of reaching to the mouth and tableware,” “ease of food intake,” “comfort of use,” “appearance: design, form, color, and acceptability of the ATD,” “dimensions: convenience of the device’s size (height, width, length),” “weight: ease in lifting and/or moving the ATD,” “ease in acquiring the ATD,” and “durability, robustness, and sturdiness of the ATD.” The items were divided into the following four categories: operating characteristics, psychological characteristics, device characteristics, and management and maintenance. Each item was evaluated using three ratings (3: matching, 2: possible matching, 1: not matching). As both patient motion and the device itself could potentially affect “simplicity of grasp,” “operability of the ATD,” “range of reaching to the mouth and tableware,” and “ease of food intake,” when level 2 evaluation was applied, this was further evaluated regarding whether improvement was required by the person operating the device or the device itself. A significant positive correlation was observed for “weight” and “comfort of use,” which appeared on both our matching assessment and the QUEST. Therefore, the proposed matching assessment tool had high validity for evaluation. As the level of coincidence for each item on the three-point scale was significantly high according to both test-retest and inter-rater results, this established the reliability of our matching criteria. Using the assessment tool, as the therapist actually observed and evaluated ATD matching during device usage, we believe that it could become a useful method for investigating improvement measures for supporting independence. In future, it will be necessary to also investigate matching criteria for other ATDs. The assessment items of psychological characteristics, device characteristics, and management and maintenance developed in this study would be applicable to other ATDs. However, for operating characteristics, each type of operation must be analyzed and appropriate evaluation items extracted because operation differs depending on the ATD used.

## KEY WORDS

assistive technology device, matching assessment tool, meal support, QUEST, development

## Introduction

Assistive technology devices (ATDs)<sup>1)</sup> are tools used to support independence in elderly and disabled individuals and to reduce the burden on caregivers. The long-term care insurance system in Japan has meant that ATD types and functions have increased, and the number of

users is raising each year<sup>2,3)</sup>. Meanwhile, because of the widespread use of the long-term care insurance system to easily loan or supply ATDs, the high number of cases in which unfitted ATDs are used is becoming a problem<sup>4,5)</sup>.

Currently, the methods of ATD evaluation that have been developed include version 2.0 of the Quebec User

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Evaluation of Satisfaction with assistive Technology (QUEST)<sup>6)</sup>, which only measures the psychological effects of devices on users, and the Psychosocial Impact of Assistive Devices Scale (PIADS)<sup>7)</sup>. Both of these have been translated into Japanese<sup>8,9)</sup>. Fitting criteria<sup>10)</sup> determined by physicians have been established for prosthesis, which are covered under public expenditure. Operation training programs and evaluation methods have also been developed for wheelchairs<sup>11-14)</sup>.

However, there are no assessment tools for objectively determining the matching of ATDs to the user's physical status and/or usage environment for ATDs that support daily physical activities such as meal support.

Therefore, the purpose of this study was to develop an assessment tool for matching meal support ATDs, and to verify the validity and reliability of this tool.

## Methods

### 1. Verification of the content validity of the fitting evaluation table

The matching assessment tool was created using the existing QUEST<sup>15)</sup> as a reference. This is because although the PIADS evaluates increases and decreases in psychological characteristics such as user self-efficacy, positive adaptability, and self-esteem brought about by the use of ATDs, the QUEST rates user satisfaction with respect to 12 service items related to ATDs. Because this study was designed to evaluate the matching of devices and users' physical status and usage environment, we used the QUEST, which is composed of items related to device properties and services, rather than the PIADS, which is composed of items focusing on psychological characteristics. The method of verification for the created matching assessment tool was also based on the method of content validity verification used for the QUEST<sup>15)</sup>.

Firstly, 24 assessment items considered necessary for matching meal support device were listed. Then, a questionnaire survey was sent via post to 40 occupational therapists specializing in ATDs. Subjects were asked to assess the 24 listed items on a 3-point scale (very important, important, or not important) according to their importance as an item for evaluating the matching of meal support devices on the basis of individual experience and knowledge. Subjects were also asked to provide comments regarding any items that should be added, items that were difficult to understand, and items that required revision.

Next, to quantify the subjective judgment of importance, matching assessment items were extracted based on the results of calculations of the proportion of therapist consensus and the results of qualitative categorization of comments.

### 2. Verification of criterion-related validity

We verified criterion-related validity by investigating the correlation between the created matching assessment tool and the external criterion of the QUEST ver. 2.0 (hereinafter "QUEST"). We used the created matching assessment tool and the QUEST to evaluate 28 meal support device users and examine correlations between the results. Spearman's rank correlation coefficient (hereinafter "r") was used for statistical analysis.

The matching assessment tool was filled in by an occupational therapist after actually watching the subject eat. They asked the subject questions regarding comfort (comfort of use) and appearance (design, form, color, and acceptability of the ATD) and filled in the answers. The QUEST was filled in by an occupational therapist who asked the subject the questions. Thus, although the matching assessment tool involved evaluation by an occupational therapist, the QUEST involved evaluation by the user.

### 3. Verification of reliability

Two occupational therapists evaluated the matching of meal support devices to verify reliability as follows.

Point 1: The same occupational therapist conducted re-evaluation 1 week later to verify intra-rater reliability with the test-retest method after actually watching the subject eat.

Point 2: Two occupational therapists evaluated the same subject to verify inter-rater reliability. They viewed video footage of the eating habits of 28 meal support device users and evaluated the matching of the meal support devices.

Point 3: Internal consistency was evaluated by investigating whether individual question items had internal consistency (whether they were a group of question items for measuring the target attribute).

Obtained data underwent linkable anonymization.

Point 4: Cohen's kappa coefficient was used for the statistical analysis of point 1 (intra-rater reliability) and point 2 (inter-rater reliability). The weighted kappa coefficient was calculated for the three-level ordinal scale. For the statistical analysis of point 3 (internal

consistency), we used Cronbach's alpha coefficient.

#### 4. Subjects

The 40 occupational therapists who were the raters of the assessment tool were arbitrarily selected from ATD advisors nationwide registered in the Japanese Association of Occupational Therapists ATD consultation system.

The two occupational therapists that evaluated the matching of meal support devices were living in I. prefecture that did not overlap with the above questionnaire subjects.

Meal support device users were recruited by asking for research participants at patient associations such as the I. Prefecture stroke, rheumatoid arthritis, ossification of posterior longitudinal ligament, cervical cord injury, and amyotrophic lateral sclerosis associations. The patients who gave their written informed consent were included as subjects for this study.

These subjects comprised 28 meal support device users with physical disabilities living in I. Prefecture. There were 10 males (M) and 18 females (F). The diseases were cervical spinal cord injury (11 subjects; 8 M, 3 F), cerebrovascular disease (5 subjects; 1 M, 3 F), Parkinson's disease (4 subjects; 1 M, 3 F), amyotrophic lateral sclerosis (3 subjects; 1 M, 2 F), muscular dystrophy (3 subjects; 3 F), spinocerebellar degeneration (1 subject; 1 F), and juvenile rheumatoid arthritis (1 subject; 1 F). Ages ranged from 32–92 years (mean age:  $61.9 \pm 16.6$  years). Three of the subjects with cervical spinal cord injury used two types of meal support devices, and the evaluation of a total of 31 meal support devices was conducted. 11 cases used chopsticks, 9 cases used spoons, 6 cases used forks, 2 cases used sporks. 6 cases with cervical cord injury used assistive devices such as the universal cuff or splint. All subjects with amyotrophic lateral sclerosis used portable spring balancer. All subjects were in the chronic phase for which a significant amount of time had passed since disease or injury onset.

#### 5. Ethical considerations

This study was approved by the Kanazawa University Special Health Sciences Medical Ethical Review Committee (approval no.: 475).

## Results

### 1. Internal validity verification results

The 24 items selected for meal support device matching assessment were classified based on attributes into the

three categories of "ease of use," "dimensions: convenience of the device's size (height, width, length) /materials," and "maintenance/inspection." The "ease of use" category contained the 12 items of "simplicity of grasp," "support/stability in hands," "contact," "operability of the ATD," "degree of freedom during use," "range of reaching to the mouth and plate/bowl," "ease of food intake," "ease in scooping the food," "food intake volume," "time required for meals," "multi-functionality," and "comfort." The "dimensions: convenience of the device's size (height, width, length) /materials" category contained the nine items of "dimensions: convenience of the device's size (height, width, length) (tip)," "dimensions: convenience of the device's size (height, width, length) (body)," "dimensions: convenience of the device's size (height, width, length) (handle)," "weight: ease in lifting and/or moving the ATD," "materials/quality," "durability, robustness, and sturdiness of the ATD," "safety: degree to which the ATD is safe, secure, and harmless," "washability," and "appearance: design, form, color, and acceptability of the ATD." The "maintenance/inspection" category contained the three items of "ease in acquiring the ATD," "ease of adjustment," and "ease of replacing parts."

Twenty occupational therapists rated the importance of fitting evaluation items for meal support devices on a 3-point scale (Table 1; response rate: 50%). They expressed a high degree of agreement ( $\geq 80\%$ : strong agreement) with respect to only one item being very important: "simplicity: simplicity of grasp." A moderate degree of agreement (between 60% and 79%) was reached regarding four items being very important: "operability of the ATD," "ease in scooping the food," "comfort," and "dimensions: convenience of the device's size (height, width, length) (handle)." There was weak agreement (40%–59%) for 13 items being very important: "weight: ease in lifting and/or moving the ATD;" "support/stability in hands," "ease of food intake," "range of reaching to the mouth and plate/bowl," "dimensions: convenience of the device's size (height, width, length) (tip)," "ease in acquiring the ATD," "durability, robustness, and sturdiness of the ATD," "safety: degree to which the ATD is safe, secure, and harmless," "materials/quality," "ease of adjustment," "washability," "appearance: design, form, color, and acceptability of the ATD," and "ease of replacing parts." A low degree of agreement ( $<40\%$ ) was shown for 6 items being very important: "Shape (body),"

Table 1. Results of agreement on the relative importance of 24 matching assessment items for meal support devices based on 20 occupational therapists

Categories for which responses of “very important” were in agreement	Meal support device evaluation item	Very important	Important	Not important	Blank space	Extracted matching assessment items
Strong agreement (≥80%)	Simplicity of grasp	16(80)	4(20)	0(0)	0(0)	Simplicity of grasp
Moderate degree of agreement (60%–79%)	Operability	12(60)	7(35)	0(0)	1(5)	Operability
	Ease in scooping food	12(60)	5(25)	2(10)	1(5)	Included in “operability”
	Comfort of use	12(60)	5(25)	2(10)	1(5)	Changed to “comfort of use”
	Shape (handle)	12(60)	5(25)	2(10)	1(5)	Included in “shape”
Weak agreement (40%–59%)	Weight	11(55)	8(40)	0(0)	1(5)	Weight
	Support/stability in hands	11(55)	7(35)	1(5)	1(5)	Included in “Simplicity of grasp”
	Ease of food intake	11(55)	7(35)	1(5)	1(5)	Ease of food intake
	Range of reaching to the mouth and plate/bowl	11(55)	6(30)	2(10)	1(5)	Range of reaching to the mouth and plate/bowl
	Shape (tip)	11(55)	6(30)	2(10)	1(5)	Combined as “shape”
	Ease in acquiring the ATD	10(50)	10(50)	0(0)	0(0)	Ease in acquiring the ATD
	Durability	10(50)	8(40)	1(5)	1(5)	Durability
	Safety	10(50)	8(40)	1(5)	1(5)	Included in “Durability”
	Materials/quality	10(50)	7(35)	2(10)	1(5)	Included in “Durability”
	Ease of adjustment	9(45)	10(50)	1(5)	0(0)	Included in “shape”
	Washability	9(45)	9(45)	1(5)	1(5)	Included in “Durability”
	Appearance	9(45)	8(40)	3(15)	0(0)	Appearance
	Ease of replacing parts	9(45)	8(40)	3(15)	0(0)	Included in “Ease in acquiring the ATD”
Low degree of agreement (<40%)	Shape (body)	7(35)	11(55)	2(10)	0(0)	Included in “shape”
	Time required for meals	6(30)	8(40)	6(30)	0(0)	Excluded as assessment items
	Food intake volume	6(30)	7(35)	7(35)	0(0)	Excluded as assessment items
	Contact (sense of fit with hands)	5(25)	9(45)	5(25)	1(5)	Excluded as assessment items
	Degree of freedom during use	4(20)	7(35)	8(40)	1(5)	Excluded as assessment items
	Multi-functionality	2(10)	10(50)	6(30)	2(10)	Excluded as assessment items

(Units: person) Figures in brackets are proportions.

“food intake volume,” “time required for meals,” “Contact (sense of fit with hands),” “Degree of freedom during use,” and “Multi-functionality”. On the other hand, a degree of agreement between 25% and 40% for 5 items being not important: “food intake volume,” “time required for meals,” “Contact (sense of fit with hands),” “Degree of freedom during use,” and “Multi-functionality”, was excluded from the matching assessment content.

Comments were classified into the categories of pertinence of the items, wording of the items (word meanings, definitions), redundancies (item duplicity), and others. The category of pertinence of the items was found to have the most comments (119 comments).

There were high numbers of pertinence of the items for “simplicity of grasp” (11 comments) and “comfort” (9 comments). Most comments related to “wording” were about the “degree of freedom during use” (7 comments), with many comments stating that this was “difficult to understand” and the “explanation was hard to comprehend.” Some comments regarding “comfort” stated that “it was difficult to understand the meaning of physical or material discomfort when using the device.” Therefore, this was changed to “comfort of use.” Many “redundancy” comments were regarding “food intake volume” (8 comments), “time required for meals” (8 comments), and “multi-functionality” (7 comments), with some subjects reporting that “food intake volume and time required for meals are unnecessary as these are not related to the match of the device” and some reporting that “as different devices are used for differently-shaped foods, multi-functionality do not need to be included in the items.” Some comments stated that “simplicity of grasp, support/stability in hands, and contact could be combined”; therefore, these were combined in “simplicity of grasp.” Furthermore, because some comments stated that “dimensions: convenience of the device’s size (height, width, length) (tip/ body/ handle) could be combined,” these were combined in “dimensions: convenience of the device’s size (height, width, length).” Some comments also indicated that “durability, robustness, and sturdiness of the ATD; safety: degree to which the ATD is safe, secure, and harmless; and washability could be combined”; therefore, these were combined in “durability, robustness, and sturdiness of the ATD.” Because comments suggested that “ease of replacing parts could be included in ease in acquiring the ATD,” this was combined in “ease in

acquiring the ATD.” “Ease of adjustment” was included in “dimensions: convenience of the device’s size (height, width, length).”

Based on these comments and the degree of agreement for items being very important or not important, a total of 10 items were selected (Table 2). These comprised four items for evaluating operating characteristics (“simplicity of grasp,” “operability of the ATD,” “range of reaching to the mouth and plate/bowl,” and “ease of food intake”), two items for evaluating psychological characteristics (“comfort of use” and “appearance :design, form, color, and acceptability of the ATD”), two items for evaluating device characteristics (“dimensions: convenience of the device’s size (height, width, length)” and “weight: ease in lifting and/or moving the ATD”), and two items for evaluating management and maintenance (“ease in acquiring the ATD” and “durability, robustness, and sturdiness of the ATD”).

Each item was evaluated using three ratings (3: matching, 2: possible matching, 1: not matching). When level 2 possible matching was applied in four items (“simplicity of grasp,” “operability of the ATD,” “range of reaching to the mouth and plate/bowl,” and “ease of food intake”), because both patient motion and the device itself could potentially affect to matching, this was further evaluated as to whether improvement was required by the person operating the device or the device itself (Table 2). Possible actions aimed at improving the management of the ATD included “motion adjustment and training to improve ability to grasp the device and operability of the ATD” and “approaches for improving posture.” Possible actions aimed at improving the device itself included “adjusting handle thickness, length, and/or angle to improve grasping and the operability of the ATD,” “using the plate/bowl that is easy to scoop,” “adjusting chair and/or table height,” and “using assistive devices such as the universal cuff or splint.”

## 2. Verification of criterion-related validity

A significant, positive correlation was observed for “weight: ease in lifting and/or moving the ATD” ( $r = 0.61$ ,  $p < 0.01$ ) (Figure 1), which appeared on both our matching assessment and the QUEST. A low positive correlation was observed for “comfort of use” ( $r = 0.32$ ,  $p < 0.05$ ) (Figure 2), which also appeared on both our assessment and the QUEST. A significant, positive correlation was also noted for our matching assessment

Table 2. Matching assessment tool for meal support device

	No	Assessment item	Degree of matching	Item definition	Assessment criteria
Operability characteristics	1	Simplicity of grasp	3 2-a 2-b 1	Whether the device is easy to grasp; whether the device can be stably held in the hands; whether the handle is thick, the handle shape should be changed, the way of holding it should be changed, whether a universal cuff or splint should be used	3: Matching (no problem) 2-a: (requires human improvement) Matching is possible with operational adjustments or practice (list specific improvement measures) 2-b: (requires device improvement) Matching possible with device or environmental adjustment (list specific improvement measures) 1: Not matching, consider another device (list reason for not matching and other countermeasures)
	2	Operability of the ATD	3 2-a 2-b 1	Whether various food shapes such as water, gels, solids, noodles, and granular shapes can be cut up, pierced, scooped, moved, and mixed easily	
	3	Range of reaching to the mouth and plate/bowl	3 2-a 2-b 1	Whether the device can adequately reach the mouth and plate, whether device and environmental adjustments [e.g., upper limb device (PSB, BFO etc.)] should be used or table height adjusted	
	4	Ease of food intake	3 2-a 2-b 1	Whether food can enter into the mouth and the device can enter the mouth easily	
Psychological characteristics	5	Comfort of use	3 2 1	Whether the device causes physical or mental pain when used	3: Matching (no problem) 2: Matching possible with some revisions to device (list specific improvement measures) 1: Not matching, consider another device (list reason for not matching and other countermeasures)
	6	Appearance : Design, form, colour, and acceptability of the ATD	3 2 1	Impressions of design, shape, color, overall balance, etc.	
Device characteristics	7	Dimensions : Convenience of the device's size (height, width, length).	3 2 1	Whether the device handle or tip shape is appropriate; whether there are any problems in length, thickness, angle, balance etc.; whether adjustments can be made; whether the tip size is appropriate; whether any damage will be caused to the mouth	1: Not matching, consider another device (list reason for not matching and other countermeasures)
	8	Weight: Ease in lifting and/or moving the ATD	3 2 1	Whether the device feels heavy, whether one can continue to eat with it	
Maintenance and management	9	Ease in acquiring the ATD	3 2 1	Whether the device can be easily acquired, whether the parts can be easily replaced	3: Commercialized 2: Can be acquired at welfare device outlets, etc. 1: Can only be made to order
	10	Durability, robustness, and sturdiness of the ATD	3 2 1	Whether materials are washable such as by heat treatment, whether it is hygienic, whether it is durable	3: Can be heat treated, no problems with safety 2: Cannot be heat treated but can be washed with water 1: Problems related to durability and safety

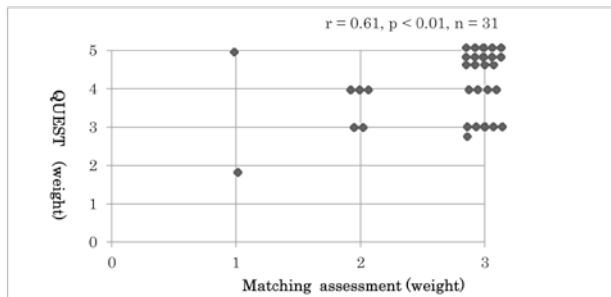


Figure 1. Correlation between the matching assessment item "weight" and the QUEST item "weight"

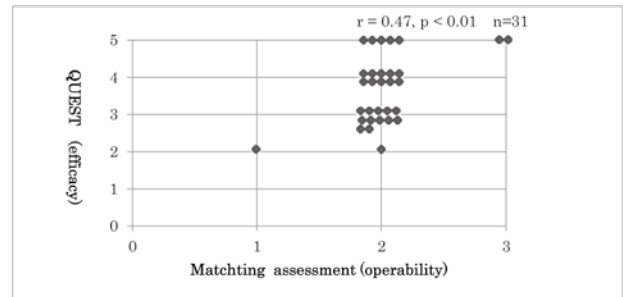


Figure 3. Correlation between the matching assessment item "operability" and the QUEST item "efficacy"

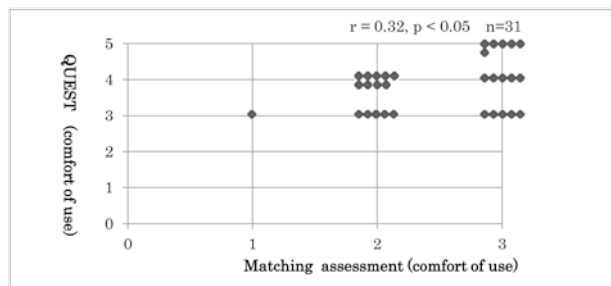


Figure 2. Correlation between the matching assessment item "comfort of use" and the QUEST item "comfort of use"

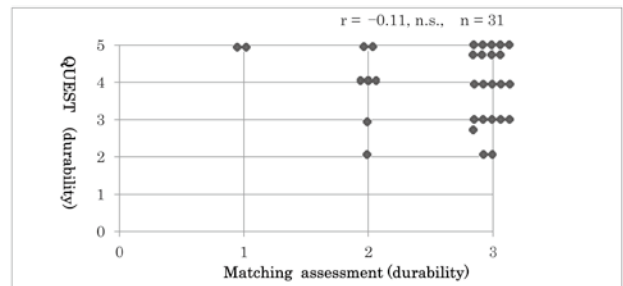


Figure 4. Correlation between the matching assessment item "durability" and the QUEST item "durability"  
(r: Spearman's rank correlation coefficient)

Table 3. Level of coincidence of the 3-point scale for ATD matching assessment test-retest and inter-rater results (n = 31)

Matching assessment items	Test-retest	Inter-rater
	Weighted kappa coefficient	Weighted kappa coefficient
(1) Simplicity of grasp	0.968 *	0.935 *
(2) Operability of the ATD	0.984 *	0.992 *
(3) Range of reaching to the mouth and tableware	0.976 *	0.968 *
(4) Ease of food intake	0.984 *	0.976 *
(5) Comfort of use	0.976 *	0.935 *
(6) Appearance	0.976 *	0.976 *
(7) Dimensions	0.968 *	0.935 *
(8) Weight	0.992 *	0.968 *
(9) Ease in acquiring the ATD	1.000	1.000
(10) Durability	0.976 *	0.935 *

\*p < 0.001

Table 4. Level of coincidence of the two levels for ATD matching assessment

Matching assessment items	Test-retest	Inter-rater
	Kappa coefficient	Kappa coefficient
(1) Simplicity of grasp	0.405 (n = 23)	0.263 (n = 21)
(2) Operability of the ATD	0.556 (n = 26)	0.284 (n = 27)
(3) Range of reaching to the mouth and tablewares	0.333 (n = 10)	0.083 (n = 11)
(4) Ease of food intake	1.000 (n = 3)	0.000 (n = 3)



item “operability of the ATD” and the QUEST item “ease of use” ( $r = 0.41$ ,  $p < 0.05$ ) as well as our matching assessment item “operability of the ATD” and the QUEST item “efficacy” ( $r = 0.47$ ,  $p < 0.01$ ) (Figure 3). Because our matching assessment item “dimensions: convenience of the device’s size (height, width, length)” included device length and size, a significant, positive correlation was noted with the QUEST item “size” ( $r = 0.45$ ,  $p < 0.01$ ). However, no correlation was noted for either with respect to “durability, robustness, and sturdiness of the ATD” ( $r = 0.10$  n.s.) (Figure 4).

### 3. Verification of reliability

#### 1) Test-retest and inter-rater reliability (Table 3)

When evaluated as 2-a or 2-b, both were considered to be “2,” and weighted kappa coefficients (hereinafter: kappa coefficients) were calculated on a 3-point scale (1, 2, 3). For all of the 10 fitting evaluation items, the kappa coefficient was at least 0.9 for both test-retest and inter-rater reliability, indicating a significantly high level of coincidence. Results for the “ease in acquiring the ATD” item were consistent in all cases.

2) For the four items related to operating characteristics, i.e., “simplicity of grasp,” “operability of the ATD,” “Range of reaching to the mouth and plate/bowl,” and “ease of food intake,” the level of coincidence was verified as to whether the user, the device, or both the user and device required improvement only when level “2” matching was applicable for the same raters and for inter-raters (Table 4). The level of coincidence was verified in all cases between the initial test and retest for the same rater for “ease of food intake.” However, the kappa coefficients were low, at 0.405 for “simplicity of grasp,” 0.556 for “operability of the ATD,” and 0.333 for “range of reaching to the mouth and plate/bowl.” The inter-rater level of coincidence was low for all items, with kappa coefficients of 0.263 for “simplicity of grasp,” 0.284 for “operability of the ATD,” and 0.083 for “range of reaching to the mouth and plate/bowl.” Although “ease of food intake” exhibited coincidence for all cases for the same rater, all inter-rater results were inconsistent (Table 4).

#### 3) Internal consistency of question items

Cronbach’s alpha coefficient was calculated to determine whether individual question items exhibited internal consistency (whether they were a group of question items for measuring the target attribute), and the results indicated a significantly high reliability of 0.848.

## Discussion

### 1. Internal validity of evaluation items

To determine items for the matching assessment tool, a questionnaire survey was conducted among specialists regarding items that they considered the most important for evaluating the matching of ATDs. As a result, the following 10 items were extracted: “simplicity of grasp;” “operability of the ATD;” “range of reaching to the mouth and plate/bowl;” “ease of food intake;” “comfort of use;” “appearance: design, form, color, and acceptability of the ATD;” “dimensions: convenience of the device’s size (height, width, length);” “weight: ease in lifting and/or moving the ATD;” “ease in acquiring the ATD;” and “durability, robustness, and sturdiness of the ATD.” The items were divided into the four categories of operating characteristics, psychological characteristics, device characteristics, and management and maintenance. Because user physical status and operative ability are relative to device matching for “simplicity of grasp,” “operability of the ATD,” “range of reaching to the mouth and plate/bowl,” and “ease of food intake,” these were classified as being in the “operating characteristics” category. With respect to “comfort of use” and “appearance: design, form, color, and acceptability of the ATD,” because some comments stated that subjective user judgment greatly affected device selection, these were classified into the psychological characteristics category. In addition, because “dimensions: convenience of the device’s size (height, width, length)” and “weight: ease in lifting and/or moving the ATD” were items that demonstrate device characteristics, they were classified into the device characteristics category. Meanwhile, “ease in acquiring the ATD” and “durability, robustness, and sturdiness of the ATD” were classified into the management and maintenance category because they were related to device maintenance and management. The results indicated that when this assessment tool, classified into the four categories, was used by an occupational therapist for matching an ATD, non-device characteristics such as user operation ability, usage environment, psychological aspects such as comfort (comfort of use), and management and maintenance could be multilaterally evaluated and readjusted. Ito<sup>5)</sup> and Kinose<sup>16)</sup> proposed that when matching an ATD, rather than making a selection based only on information such as the ATD shape, function, and size, one should conduct an evaluation related to

physical, mental, and psychological aspects in addition to considering assistive ability, living environment, and social environment. We were able to establish the validity of the evaluation items extracted in this study and categorized characteristics.

## 2. Criterion-related validity

A significant, positive correlation was observed for “weight” and “comfort of use”, which appeared on both our matching assessment and the QUEST. For items with a similar evaluation content, significant, positive correlations were noted between our matching assessment item “dimensions: convenience of the device’s size (height, width, length)” and the QUEST item “size,” our matching assessment item “operability of the ATD” and the QUEST item “ease of use,” and our matching assessment item “operability of the ATD” and the QUEST item “efficacy.” Thus, the results suggested that our matching assessment items “dimensions: convenience of the device’s size (height, width, length),” “weight: ease in lifting and/or moving the ATD,” “operability of the ATD,” and “comfort: comfort of use” correlate with user psychological satisfaction and that these have high validity as evaluation criteria.

Meanwhile, the lack of a correlation between the two for “durability, robustness, and sturdiness of the ATD” may have been due to a qualitative difference in evaluation content. Because although our assessment tool investigated whether heat processing of the meal support device was possible or if there were problems related to durability or safety of the ATD, the QUEST involved the subjective evaluation of satisfaction regarding the “durability, robustness, and sturdiness of the ATD.”

## 3. Test-retest and inter-rater reliability

Because the level of coincidence for each item on the three-point scale was significantly high according to both test-retest and inter-rater results, this established the reliability of our created matching criteria. However, because our created matching assessment tool was a three-point scale, this low level of variation in evaluation may have led to the high level of coincidence.

The four items, i.e., “simplicity of grasp,” “operability of the ATD,” “range of reaching to the mouth and plate/bowl,” and “ease of food intake” were evaluated after being further classified into two levels according to whether the human or device required improvement. The level of coincidence for improvement measures was moderate for test-retest results but hardly coincided for

inter-rater results. It appeared that factors related to this difference could be the different opinions of occupational therapists regarding operational adjustments and practice and the different improvement measures according to the device and/or environment. The results suggested that in the future, data on more ATD matching devices need to be gathered, and relationships with impairment characteristics and device matching methods need to be investigated. In the cervical spinal cord injury, there is a possibility that the remaining functions of the upper limbs are important factor in selecting meal support ATDs. In amyotrophic lateral sclerosis there is a possibility that progress of the disease affects the use of portable spring balancer and the weight of spoon/fork.

## 4. Significance to develop matching assessment tool

Although ATDs have been widely used since the introduction of the long-term care insurance system in Japan, accidents and adverse effects have occurred because of the incorrect usage of devices and poor physical fitting<sup>5,17,18)</sup>. Therefore, occupational therapists should cooperate with care managers, specialized ATD consultants, and the patient’s family to offer explanations on the purpose of using ATDs and to give adequate advice regarding the selection and methods of using appropriate devices<sup>17,19)</sup>.

Generally, occupational therapist matches with disabilities and ATDs as follows<sup>16)</sup>.

Step 1: Making sure the demands and needs

Step 2: Evaluation

Step 3: Selection and matching with disability and ATD

Step 4: Evaluation for trial use

Step 5: Adjustment, modify and change

Step 6: Decide to utilize ATD

Step 7: Re-evaluation

Step 8: Evaluation of actual use

Step 9: Follow up

First, when selecting the ATD (Step 2, 3), an occupational therapist evaluates the suitability using this matching assessment tool. Through the process of adjustment, modify and change (Step 5), at the time of re-evaluation (Step 7), she evaluates the suitability using this matching evaluation tool again. Based on the results of matching assessment, she describes the selection reason to care manager and family at the step 8. If our assessment tool was used clinically in the manner described above, this could make it possible that not only the occupational

therapist but also the patient and his family understand his ability, comfort of use, device characteristics, and management and maintenance. It would also be useful for determining the cause of poor matching if a problem occurred after use.

The QUEST and PIADS evaluations involve asking the user about their satisfaction and psychological changes after using the device. In contrast, By using our matching assessment tool, because the therapist actually observe and evaluate the ATD matching during device usage, we believe that it could become a useful method for investigating improvement measures for supporting independence. In the future, if data on more cases of usage of our matching assessment tool could be gathered and relationships between ATDs and physical function and operation ability could be analyzed, our method could aid in optimal ATD selection.

#### 5. Study limitations

Out of the diverse range of ATDs available, we developed a matching assessment tool limited only to meal support devices, which are frequently used in daily life. In the future, it will be necessary to also investigate matching criteria for other ATDs. The assessment items of psychological characteristics, device characteristics, and management and maintenance created in this study appear to be characteristics that can also be applied to

other ATDs. However, for “operating characteristics,” each type of operation needs to be analyzed and appropriate evaluation items extracted because operation differs depending on the ATD used.

The meal support device users examined in this study were all patients in the chronic phase for whom a significant amount of time had passed since disease or injury onset. Thus, they were already familiar with using a meal support device tailored to them. In the future, we hope to investigate the contents of the approach and follow-up by experts for the match with ATDs using this assessment tool in the acute and recovery phases when little time has passed since disease or injury onset. Then, considering the relationships with impairment characteristics and device matching methods, we would like to continue to pursue assessment tool that can determine possibilities and predict human or device-related improvements.

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## 食事動作のための福祉用具の適合評価表の作成 ―妥当性と信頼性の検討―

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### 要 旨

食事を支援する福祉用具に限定して適合評価表を作成し、妥当性と信頼性を検証した。福祉用具を専門とする作業療法士 40 名を対象に食事用具の適合評価に必要と考えられる 24 項目から「大変重要」と思う項目についてアンケート調査した。把持のしやすさ、操作性、口や食器までの到達度、食物の取り込みやすさ、使い心地、外観、形状、重さ、入手しやすさ、耐久性の 10 項目が抽出され、動作特性、心理特性、用具特性、維持管理の 4 つのカテゴリーに分類した。各項目は 3 段階 (3: 適合している、2: 調整により適合する可能性あり、1: 適合していない) で判定した。把持のしやすさ、操作性、口や食器までの到達度、食物の取り込みやすさは、2 の段階において人と物の改善余地について細区分して評価した。食事用具利用者 28 名を対象に作成した適合評価表と QUEST 第 2 版を実施したところ、重さ、使い心地等の同一項目間で有意な正の相関を認め基準関連妥当性が立証された。全項目において再検査、検者間ともに判定の一致度は有意に高く信頼性も立証された。作成した評価法は適合状況について福祉用具の使用場面を観察して評価するため自立支援の改善策を検討する有用な手段になり得るだろう。今後は、他の福祉用具に対しても適合評価法を検討していく必要がある。心理特性、用具特性、維持管理の評価項目は共通して使用できるが、動作特性は使用する福祉用具によって動作が異なるため各動作を分析して評価項目を抽出する必要がある。