J Nutr Health Aging. 2020;24(1):28-36

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ASSIGNMENT OF DENTAL HYGIENISTS IMPROVES OUTCOMES IN JAPANESE REHABILITATION WARDS: A RETROSPECTIVE COHORT STUDY

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Abstract: *Objectives:* To clarify the effectiveness of ward-assigned dental hygienists (DHs) on rehabilitation outcomes in rehabilitation wards. *Design:* Retrospective cohort study. *Setting:* The registry data from the Japanese Rehabilitation Nutrition Database. *Participants:* 656 patients with hip fracture or stroke admitted to convalescent rehabilitation wards. *Measurements:* The main outcome measures were the Functional Independence Measure (FIM), the Food Intake Level Scale (FILS), and the home discharge rate. Patients were divided into two groups based on the ward setting: with an assigned DH (DH group) and without an assigned DH (NDH group). Clinical characteristics and outcomes were compered between the groups. Between-facility differences were adjusted by generalized estimating equation. We performed post-hoc power analysis to confirm that there were enough samples included in this study to detect a significant difference. *Results:* Of 656 patients (mean age, 77 years; 57.1% female; 65.5% stroke) from 10 facilities, 454 patients (69.2%) from 4 facilities were in the DH group. FIM score at discharge (107 vs 90, P<0.001), percentage improvement in FILS score from admission to discharge (44.5% vs 22.8%, P<0.001) and home discharge rate (72.5% vs 61.4%, P<0.001) were significantly higher in the DH group than in the NDH group. After multivariate analysis, the FIM score at discharge (P=0.007), FILS score at discharge (P=0.024), and home discharge rate (P=0.007) were significantly higher in the DH group than in the NDH group. *Conclusions:* ADL and swallowing function were significantly improved at discharge and the home discharge rate was higher among patients in rehabilitation wards with DHs. Having a ward-assigned DH may lead to better rehabilitation outcomes in rehabilitation wards.

Key words: Activities of daily living, dental hygienist, oral care, rehabilitation, swallowing function.

Introduction

Poor oral health is common, with a reported prevalence of 71%–85% in rehabilitation hospitals (1-3). Oral health is associated with overall health but often receives less attention in rehabilitation settings. The WHO defines oral health as "a state of being free from chronic mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking, and psychosocial well-being." (4) From this definition, poor oral health means poor oral hygiene as well as oral dysfunction. Poor oral health has been observed among patients following acute stroke (2, 3, 5) and is associated with poor overall health and rehabilitation outcomes among older people (2, 3) including malnutrition (1,5), dysphagia (6), sarcopenia (5), and dependence in activities of daily living (ADL) (2). Malnutrition, dysphagia, and sarcopenia, which are common and serious issues in older people undergoing rehabilitation, have negative effects on rehabilitation outcomes (7, 8). Thus, improvement in oral hygiene is important to promote better health and rehabilitation outcomes for older people.

Given the increased need for oral management in rehabilitation settings, the involvement of dental professionals in rehabilitation has become important. Dental hygienists (DHs) are licensed oral health care professionals who take various roles in oral health management. Oral health management includes oral hygiene management with clinical procedures to improve or maintain oral hygiene, and oral function management with clinical procedures to improve oral function. In particular, DHs perform oral screening and assessment; administer oral prophylaxis; provide oral functional training; provide dysphagia rehabilitation; offer care planning and technical instruction to health care professionals and patients; and assist dentists (9-11). They may also work as a member of a multidisciplinary team such as a nutritional support team or dysphagia therapy team. The effectiveness of oral health management by DHs has been demonstrated in several studies. Intervention by DHs effectively reduces plaque scores among residents living in residential aged care facilities (12). Professional oral care by DHs reduces the incidence of respiratory infections (13) and the risk of developing ventilator-associated pneumonia among critically ill patients (14). Oral functional training by DHs contributes to maintaining and improving feeding function among older

Received May 26, 2019
Accepted for publication July 31, 2019
Published online October 17, 2019, http://dx.doi.org/10.1007/s12603-019-1284-9

people, leading to improved nutritional status (15). Furthermore Shiraishi et al. reported that DH oral management improves patient outcomes, including activities of daily living, home discharge and in-hospital mortality in post-acute rehabilitation (9). Considering the favorable effects of professional oral health management, the presence of DHs in rehabilitation wards is important.

DHs play a central role in oral health management for older people undergoing rehabilitation, and thus are allocated to rehabilitation wards in some facilities in Japan. However, it is not yet clear whether allocation of DHs to convalescent rehabilitation wards improves rehabilitation outcomes such as swallowing function, ADL, and home discharge.

The aim of this study was to use the Japan Rehabilitation Nutrition Database to clarify the effectiveness of ward-assigned DHs on rehabilitation outcomes in convalescent rehabilitation wards.

Methods

This was a retrospective cohort study using data registered in the Japan Rehabilitation Nutrition Database (JRND). The primary outcome was the Functional Independence Measure (FIM) score at discharge, and the secondary outcomes were the Food Intake Level Scale (FILS) score and the percentage of patients discharged home.

Definition of ward assignment for dental hygienists

There is not yet a common standard for the placement of DHs in Japan. Therefore, we adopted the pharmacist ward-assignment standard as the ward-assignment standard for DHs in this study. Specifically, allocation of DHs to a rehabilitation ward was defined as performing dental hygiene duties in the allocated ward for more than 20 h per week.

The JRND

The JRND was established by the Japanese Association of Rehabilitation Nutrition, which aims to contribute to improving the quality of rehabilitation medicine through clinical research on rehabilitation nutrition. To be recruited, a facility is required to participate in research as a member of the Japanese Association of Rehabilitation Nutrition. The targeted patients are those over 20 years old who are admitted for rehabilitation and have cerebral infarction, cerebral hemorrhage, subarachnoid hemorrhage, femoral neck fracture, or femoral trochanter fracture. All targeted cases were registered on admission and followed up until discharge. Fifteen facilities participated, of which 10 facilities had convalescent wards, and data for 1,105 patients was entered between March 2016 and March 2018. Patient consent for enrollment in the JRND was obtained by an opt-out option in participating facilities. The quality of this database has been verified previously (16). Supporting information shows hospital characteristics of 10 facilities included in this study.

In Japan, intensive and comprehensive rehabilitation medicine is conducted for patients with disabilities by a professional health care team, with an aim to improve ADL and social reintegration. For this study, we obtained data of patients with stroke or hip fracture who were admitted to convalescent rehabilitation wards, and patients were divided into two groups based on the ward setting: with an assigned DH (DH group) and without an assigned DH (NDH group). Of 10 facilities that registered data for patients with stroke and patients with hip fracture, 4 facilities had a DH assigned to the convalescent rehabilitation ward. Data collected on admission were as follows: age, sex, body weight, height, Charlson Comorbidity Index score (17), residence before admission, pre-injury or onset long-term care insurance (LTCI) certification, days between onset and admission to the convalescent rehabilitation ward, number of beds in the rehabilitation ward, FIM score, FILS score, and Mini Nutritional Assessment Short-Form (MNA-SF) score. Discharge data were discharge destination, body weight, FIM score, FILS score, MNA-SF score, total units of rehabilitation therapy with a speech therapist, and length of stay.

LTCI is a public health insurance system in Japan. LTCI certification is based on the required amount of assistance in ADL, rated from 1 (least assistance) to 7 (maximum assistance).

ADL

ADL was evaluated with the FIM, which is a validated and reliable tool for ADL assessment (18). The FIM is composed of 13 motor domains and 5 cognitive domains, and each domain is scored from 1 (total assistance) to 7 (complete independence). Total FIM score ranges from 18 to 126, with higher FIM scores indicating higher independence in ADL.

Swallowing function

Swallowing function was evaluated with the FILS, which is a validated tool for measuring the severity of dysphagia (19) and is widely accepted in Japan. The FILS is scored from 1 (severe dysphagia) to 10 (normal). In this study, swallowing function was considered improved if the FILS score at discharge was at least 1 point higher than the score at admission.

Nutritional status

Nutritional status was assessed by the MNA-SF (20). The MNA-SF is composed of six domains, each scored on a 3-point scale (0 to 2) or 4-point scale (0 to 3) depending on the domain. Nutritional status is classified according to the total MNA-SF score, as follows: 0 to 7 points, malnourished; 8 to 11 points, at risk for malnutrition; 12 to 14 points, well-nourished. In this study, patients with an MNA-SF score of 0–7 points at admission were considered to have improved nutritional status if their score increased to 8–14 points at discharge.

Table 1
Patient characteristics at admission in rehabilitation wards with or without ward-assigned dental hygienists

	Total				Stroke				Hip fracture			
	Total n=656	**Without ward-assigned DH n=202**	**With ward-assigned DH n=454**	**P-value**	**Total n=430**	**Without ward-assigned DH n=72**	**With ward-assigned DH n=358**	**P-value**	**Total n=226**	**Without ward-assigned DH n=130**	**With ward-assigned DH n=96**	**P-value**
Age, y, mean (SD)*	77 (11)	82 (9)	75 (1)	<.001†	74 (11)	79 (9)	73 (11)	<.001†	83 (9)	83 (9)	84 (8)	.398†
Female, n (%)	375 (57.1)	143 (70.8)	232 (51.1)	<.001‡	196 (45.6)	39 (54.2)	157 (43.9)	.141‡	179 (79.2)	104 (80.0)	75 (78.1)	.859‡
Disease category, n (%)				<.001‡								
Stroke	430 (65.5)	72 (35.6)	358 (78.9)									
Proximal femoral fracture	226 (34.5)	130 (64.4)	96 (21.1)									
CCI score, median (IQR)	1 (0-2)	1 (0-2)	1 (0-2)	.635§	1 (0-2)	1 (1-2)	1 (0-2)	.255§	1 (0-2)	1 (0-2)	1 (0-2)	.978§
Pre–injury onset residence, n (%)				<.001‡				.003‡				.086‡
Home	609 (92.8)	176 (87.1)	433 (95.4)		405 (94.2)	63 (87.5)	342 (95.5)		204 (90.3)	113 (86.9)	91 (94.8)	
Care facility	39 (5.9)	25 (12.4)	14 (3.1)		19 (4.4)	9 (12.5)	10 (2.8)		20 (8.9)	16 (12.3)	4 (4.2)	
Hospital	7 (1.1)	0 (0.0)	7 (1.5)		6 (1.4)	0 (0.0)	6 (1.7)		1 (0.4)	0 (0.0)	1 (1.0)	
Other	1 (0.2)	1 (0.5)	0 (0.0)		0 (0.0)	0 (0.0)	0 (0.0)		1 (0.4)	1 (0.8)	0 (0.0)	
Days between onset and admission, median (IQR)	23 (17-35)	23 (17-33)	24 (16-36)	.663§	24 (15-38)	25 (18-36)	24 (15-38)	.193§	22 (18-31)	22 (17-30)	23 (20-31)	.041§
Pre-injury onset certification for LTCI, n (%)**	239 (36.4)	102 (50.5)	137 (30.6)	<.001‡	137 (31.9)	29 (40.3)	108 (30.4)	.135‡	102 (45.1)	73 (56.2)	29 (31.5)	<.001‡
FIM, median (IQR)	67 (40-89)	65 (40-88)	70 (40-90)	.544§	65 (34-89)	48 (31-82)	68 (35-90)	.089§	71 (52-90)	69 (46-90)	74 (57-89)	.214§
FILS, median (IQR)	9 (7-10)	9 (8-10)	9 (7-10)	.222§	8 (7-10)	8 (7-9)	8 (7-10)	.020§	9 (8-10)	10 (8-10)	9 (8-10)	.284§
BMI, kg/m^2, mean (SD)††	21.1 (3.6)	20.5 (3.4)	21.3 (3.6)	.004†	21.5 (3.6)	21.0 (3.5)	21.6 (3.7)	.154†	20.2 (3.2)	20.2 (3.3)	20.1 (3.1)	.822†
MNA-SF score, median (IQR)	6 (4-8)	7 (5-8)	6 (4-8)	.210§	6 (4-8)	6 (5-8)	6 (4-8)	.900§	6 (4-8)	7 (5-8)	5 (4-7)	.002§

BMI, body mass index; CCI, Charlson Comorbidity Index; DH, dental hygienist; FILS, Food Intake Level Scale; FIM, Functional Independence Measure; IQR, interquartile ratio; LTCI, long-term care insurance; MNA-SF, Mini Nutritional Assessment-Short Form; SD, standard deviation; *Age: 1 missing; †Unpaired t-test; ‡Chi-squared test; §Mann-Whitney U test; **Pre–injury onset certification for LTCI: 7 missing; ††BMI: 2 missing

Home discharge rate

Destinations after discharge from the convalescent rehabilitation ward were categorized as home or other (general ward, rehabilitation ward, medical long-term care ward, nursing facility, or death). The prevalence of home discharge was expressed as the percentage of patients who were discharged home.

Employment status and duties of DHs

We obtained detailed information about employment status and details of the duties of ward-assigned DHs by sending questionnaires to ward-assigned DHs in four hospitals registered in the JRND. The information obtained included the number and working status of DHs and dentists employed, the duties being performed in the ward to which they were assigned, and participation in a multidisciplinary team.

Dysphagia rehabilitation is partly covered by Japanese medical insurance for patients with acute stroke within 14 days of onset (with each session lasting over 15 min), and for patients with dysphagia or with stroke after 15 days (with each session lasting over 30 min).

Statistical analysis

Statistical analysis was performed using EZR Version 2.4-0 (21) and SPSS Statistics Version 24.0. Variables were compared between groups using the unpaired t-test, chi-squared test, Mann-Whitney U test, or Fisher's exact test, as appropriate. Multivariate analysis using a generalized estimating equation (GEE) was performed to adjust for between-facility differences in the following variables: age; comorbidities; days from onset to admission to the rehabilitation ward; FIM, MNA-SF, and FILS scores at admission; and number of beds in the rehabilitation ward. A P-value less than 0.05 was considered statistically significant. We performed post hoc power analysis to confirm that the sample size was large enough to detect significant differences.

Table 2

Patient characteristics at discharge in rehabilitation wards with or without ward-assigned dental hygienists

	Total				Stroke				Hip fracture			
	Total n=656	**Without ward-assigned DH n=202**	**With ward-assigned DH n=454**	**P-value**	**Total n=430**	**Without ward-assigned DH n=72**	**With ward-assigned DH n=358**	**P-value**	**Total n=226**	**Without ward-assigned DH n=130**	**With ward-assigned DH n=96**	**P-value**
FILS												
Score, median (IQR)	9 (7-10)	9 (8-10)	9 (9-10)	.001*	9 (8-10)	9 (8-9)	10 (9-10)	<.001§	9 (8-10)	10 (8-10)	9 (9-10)	.462§
Improved, n (%)	248 (37.8)	46 (22.8)	202 (44.5)	<.001†	202 (47.0)	29 (40.3)	173 (48.3)	.211†	46 (20.4)	17 (13.1)	29 (30.2)	<.001†
Gain, median (IQR)	0 (0-1)	0 (0-0)	0 (0-1)	<.001†	0(0-1)	0(0-1)	0(0-2)	.047§	0 (0-0)	0 (0-0)	0 (0-1)	.002§
FIM												
Score, median (IQR)	102 (69-118)	90 (61-112)	107 (73-121)	<.001*	102 (62-120)	82 (42- 108)	106 (69-121)	<.001§	103 (76-116)	96 (72-112)	111 (89-120)	<.001§
Gain, median												
(IQR)	24 (12-36)	18 (8-29)	27 (14-40)	<.001*	24 (10-38)	15 (2-26)	26 (13-40)	<.001§	23 (12-33)	20 (9-30)	29 (19-37)	<.001§
Efficiency, median (IQR)	0.30 (0.16-0.49)	0.26 (0.10-0.43)	0.32 (0.18-0.50)	<.001*	1.28 (.31-1.39)	1.04 (.25-1.17)	1.33 (.31- 1.40)	<.469§	1.05 (.68-1.67)	1.01 (.64-1.63)	1.08 (.73-1.73)	<.277 §
MNA-SF												
Score, median (IQR)	9 (7-11)	9 (7-10)	10 (8-11)	.001*	10 (8-11)	9 (7-10)	10 (8-11)	.004§	9 (7-11)	9 (7-10)	9 (8-11)	.564§
Improved, n (%)	297 (66.3)	78 (57.4)	219 (70.2)	.011†	351 (81.6)	56 (77.8)	295 (82.4)	.449†	192 (85.0)	104 (80.0)	88 (91.7)	.025†
Gain, median (IQR)	3 (1-5)	2 (1-4)	3 (1-5)	<.001*	3 (1-5)	2 (1-4)	3 (1-5)	.011§	3 (1-4)	3 (1-4)	4 (2-5)	<.001§
Total ST units, median *** (IQR)	200 (100-335)	161 (70-240)	214 (118-343)	.015*	213 (109-337)	203 (77-245)	215 (118-344)	.103§	39 (28-60)	39 (28-60)	NA	NA§
LOS, days, median (IQR)	80 (51-113)	73 (50-90)	84 (52-124)	.004*	96 (55-132)	96 (56-140)	97 (55-131)	.562§	66 (49-85)	66 (50-85)	67 (48-84)	.846§
Discharged home, n (%)	453 (69.1)	124 (61.4)	329 (72.5)	<.001†	289 (67.2)	36 (50.0)	253 (70.7)	.001†	164 (72.6)	88 (67.7)	76 (79.2)	.049†

DH, dental hygienist; FILS, Food Intake Level Scale; FIM, Functional Independence Measure; LOS, length of stay MNA-SF, Mini Nutritional Assessment-Short Form; ST, speech therapist.

Table 3
Details of employment status and professional duties being performed in the ward

	Hospital			
	A	**B**	**C**	**D**
Employment status of dental hygienist, n				
Full-time	3	4	4	3
Part-time	5	0	0	0
Ward assigned	4	4	3	3
Employment status of dentist, n				
Full-time	1	0	0	0
Part-time	4	0	1	0
Professional duties				
Oral screening, assessment		✓	✓	✓
Oral care (cleaning)	✓	✓	✓	✓
Oral functional training		✓	✓	✓
Assistance to dentist*		✓	✓	✓
Providing oral care plan and technical instruction to other healthcare staff	✓	✓	✓	✓
Dysphagia rehabilitation covered by medical insurance			✓	✓
Dysphagia rehabilitation not covered by medical insurance			✓	✓
Providing oral care plan and technical instruction to patients		✓	✓	✓
Counseling for patients			✓	✓
Participation in multidisciplinary team				
Nutritional support	✓		✓	✓
Dysphagia	✓		✓	
Rehabilitation nutrition				✓
Rehabilitation ward staff		✓		

* In hospitals B and D where no dentists were employed, dentists visit those hospitals for dental care from other hospital or community dental clinic. Dental hygienists are assisting those visiting dentists.

Results

Among 1,105 patients enrolled in the JRND, 684 were patients with stroke or hip fracture admitted to convalescent rehabilitation wards. After exclusion of 28 patients with missing data for FIM score, FILS score, MNA-SF score, or discharge destination, 656 patients were included in the final study sample (mean age, 77 years; 57.1% female). Patient characteristics at admission are shown in Table 1. Of 15 facilities, 10 registered data from convalescent rehabilitation wards and 4 had a ward-assigned DH. There were 454 patients (69.2%) assigned to the DH group and 202 assigned to the NDH group. There were no statistically significant between-group differences in FIM score (P=0.554), FILS score (P=0.222), and MNA-SF score (P=0.210) at admission. Among stroke patients, FILS score at admission was lower in the NDH group (P=0.02). Among hip fracture patients, number of pre-injury onset certification for LTCI and MNA-SF score at admission was higher in the NDH group.

Table 2 shows patient characteristics at discharge. Median FIM score (107 vs 90, P<0.001) and median MNA-SF score (10 vs 9, P=0.001) at discharge were significantly higher in the DH group compared with the NDH group. The DH group also had a significantly higher median (interquartile ratio) FILS score at discharge (9 [9-10] vs 9 [8-10], P=0.001), percentage improvement in FILS score from admission to discharge (44.5% vs 22.8%, P<0.001), and home discharge rate (72.5% vs 61.4%, P<0.001). Among stroke patients, FILS score, FIM score and MNA-SF score at discharge were significantly higher in the DH group. Among hip fracture patients, improvement in nutritional status and FILS score, as well as FIM score at discharge were higher in the DH group. Furthermore, the rate of home discharge was higher in the DH group both in stroke patients and in hip fracture patients.

Table 3 shows information about the employment status and professional duties of DHs. Three to four ward-assigned DHs were allocated to each facility. The main duties of ward-assigned DHs were assisting dentists, conducting oral screening assessments and oral cleaning, and providing oral care plans and technical instruction to other health care staff. At two of

Table 4
Multivariate generalized estimation equation analysis for Functional Independence Measure and Food Intake Level Scale scores at discharge

	FIM at discharge				FILS at discharge			
	B	95% CI		P-value	B	95% CI		P-value
		Lower	Upper			Lower	Upper	
With ward-assigned DH	7.747	2.129	13.366	.007	0.305	.041	.569	.024
Without ward-assigned DH	0	–	–	–	0	–	–	–
Age	-.304	-.415	-.193	<.001	-.015	-.024	-.007	<.001
Sex								
Male	-.299	-3.755	3.158	.865	-.017	-.185	.151	.845
Female	0	–	–	–	0	–	–	–
Disease category								
Proximal femoral fracture	1.542	-.320	3.404	.105	-.132	-.286	.022	.093
Stroke	0	–	–	–	0	–	–	–
CCI	-.673	-1.784	.437	.234	-.008	-.135	.118	.898
Days between onset and admission	-.108	-.131	-.084	<.001	-.007	-.009	-.005	<.001
FIM at admission	.729	.628	.831	<.001	.005	.001	.008	.010
MNA-SF at admission								
12–14 points (normal)	.230	-5.058	5.518	.932	.070	-.183	.323	.588
8–11 points (at risk of malnutrition)	-.005	-4.840	4.831	.999	-.104	-.297	.089	.291
0–7 points (malnutrition)	0	–	–	–	0	–	–	–
FILS at admission	2.401	1.627	3.175	<.001	.521	.410	.631	<.001
Number of beds								
≤50	.939	-5.203	7.081	.765	.242	-.220	.704	.304
51–100	-6.528	-10.944	-2.111	.004	-.034	-.550	.482	.897
≥101	0	–	–	–	0	–	–	–

CCI, Charlson Comorbidity Index; DH, dental hygienist; FILS, Food Intake Level Scale; FIM, Functional Independence Measure; MNA-SF, Mini Nutritional Assessment-Short Form.

the four facilities, DHs performed dysphagia rehabilitation and counseling for patients. DHs also participated in multidisciplinary teams such as the nutritional support team, dysphagia team, and rehabilitation nutrition team.

Tables 4 and 5 show the results of multivariate GEE analysis for FIM and FILS scores at discharge, home discharge, and improvement in nutritional status. After adjustment for facility characteristics, FIM score at discharge (B=7.747, 95% confidence interval [CI]: 2.129-13.366, P=0.007), FILS score at discharge (B=0.305, 95% CI: 0.041-0.569, P=0.024) and the home discharge rate (odds ratio [OR]=3.455, 95% CI: 1.401-8.519, P=0.007) remained significantly higher in the DH group compared with the NDH group. There was no significant between-group difference in nutritional status (MNA-SF) at discharge (OR=0.535, 95% CI: 0.248-1.158, P=0.113).

Post hoc power analysis revealed an effect size d of 0.3 calculated by the difference in mean±standard deviation in the FIM score at discharge; statistical power was 0.95 as calculated with α error=0.5, showing that the sample size was adequate in this study.

Discussion

This study produced three novel findings: among stroke and hip fracture patients in rehabilitation wards with an assigned DH, (1) independence in ADL was significantly higher at discharge, (2) the home discharge rate was higher, and (3) swallowing function was significantly better at discharge.

First, as in previous studies (9, 12, 22), independence in ADL was significantly higher at discharge among patients in wards with assigned DHs. DHs provide guidance on appropriate oral care to other health care professionals and caregivers as well as to patients themselves, improving oral care skills and patients' overall oral health (24). Instructing patients in oral care techniques such as brushing is also an important role of DHs (11), and improved oral self-care as a grooming

Table 5
Multivariate generalized estimation equation analysis of discharge home and improvement in nutritional status at discharge

	Discharge home				Normal nutritional status			
	Odds ratio	95% CI		P-value	Odds ratio	95% CI		P-value
		Lower	Upper			Lower	Upper	
With ward-assigned DH	3.455	1.401	8.519	.007	.535	.248	1.158	.113
Without ward-assigned DH	1.000	–	–	–	1.000	–	–	–
Age	.972	.951	.993	.009	.979	.964	.995	.010
Sex								
Male	.850	.516	1.401	.524	1.165	.693	1.959	.564
Female	1.000	–	–	–	1.000	–	–	–
Disease category								
Proximal femoral fracture	1.340	.653	2.749	.425	.918	.616	1.368	.673
Stroke	1.000	–	–	–	1.000	–	–	–
CCI	.906	.817	1.004	.061	1.068	.984	1.159	.118
Days between onset and admission	.995	.988	1.002	.159	.994	.983	1.006	.328
FIM at admission	1.034	1.017	1.050	<.001	1.003	.993	1.013	.516
MNA-SF at admission								
12–14 points (normal)	1.368	.830	2.256	.219	.185	.057	.601	.005
8–11 points (at risk of malnutrition)	1.960	.882	4.355	.098	.797	.230	2.759	.720
0–7 points (malnutrition)	1.000	–	–	–	1.000	–	–	–
FILS at admission	1.119	1.014	1.234	.025	1.298	1.121	1.504	.001
Number of beds								
≤50	.414	.127	1.354	.145	4.820	1.666	13.946	.004
51–100	.547	.203	1.476	.234	4.126	1.784	9.541	.001
≥101	1.000	–	–	–	1.000	–	–	–

CCI, Charlson Comorbidity Index; DH, dental hygienist; FILS, Food Intake Level Scale; FIM, Functional Independence Measure; MNA-SF, Mini Nutritional Assessment-Short Form.

component leads to improved FIM scores. Oral health is associated with nutritional status and the amount of the oral intake (24). Malnutrition and dysphagia are related to poor physical function (8, 25), and poor oral health at hospital admission is associated with physical function at discharge (2, 3). Furthermore, improvement in nutritional status and food intake is associated with improved ADL (26, 27). Improved occlusal force is linked to better standing and walking function, suggesting improvement in ADL (25). Thus, improvement of oral status through DH intervention may have promoted ADL improvement in the present study.

Second, the home discharge rate was higher among patients in rehabilitation wards with assigned DHs. Factors that contribute to home discharge include nutritional status, amount of oral intake, swallowing function, cognitive function, independence in ADL (28), as well as environmental and economic factors. In long-term care facilities, enhanced oral care—including the prevention of pneumonia, glycemic control, and nutritional intervention—improves patients' general condition and promotes home discharge (23). In the present study, swallowing function and ADL were significantly higher at discharge among patients in rehabilitation wards with assigned DHs, allowing a higher percentage of patients to be discharged home. Furthermore, continuous oral health management by dental professionals following discharge could prevent readmission to health care facilities and help enable patients to continue living in the community.

Third, swallowing function was significantly higher at discharge among patients in rehabilitation wards with an assigned DH. Oral and occlusal statuses, including the use of dentures, are associated with eating and swallowing function and food selection (24, 29). Furthermore, in the rehabilitation wards included in this study, the ward-assigned DH performed oral rehabilitation for eating and swallowing, helping to improve swallowing function and rehabilitation outcomes. However, in Japan, 90% of DHs work in community dental clinics, while only 5% work in hospitals. It may be beneficial if DHs have more opportunities to be active in hospitals (30).

This study has several limitations. First, differences in the quality of care among facilities may have influenced the outcome of this multicenter study. To account for this, we performed multivariate GEE analysis to correct for differences in facility characteristics. Although the variables were limited to those available in the JRND, we chose variables that were assumed to affect the study outcomes. Second, information on oral health and/or functional status is important to verify the impact of intervention by DHs. However, information on oral health or oral functional status was not included in the JRND, and so we could not obtain data on this. This is a limitation of a database study. However, previous studies provide sufficient evidence to show that intervention by DHs improves patients' oral status and /or oral function (9, 12-14, 31). Ward-assigned DHs also play important roles in providing oral care planning and technical instruction to other healthcare staff. Oral care programs are effective in promoting oral health and maintaining oral intake (32). Collaboration between DHs and other health professionals leads to improvement of oral status (33). Considering that ward-assigned DHs spend more than half of their working hours in the assigned ward and perform their professional duties for patients and other health care professionals, it is no exaggeration to say that the assignment of DHs in the rehabilitation ward contributes to improvement of oral status. Third, this was a retrospective investigation of the effectiveness of ward-assigned DHs. Shiraishi et al. have reported the importance of intervention by DHs in improving rehabilitation outcomes in a single-center study (9). The findings of our multicenter study are consistent with their results. In the future, larger multicenter and prospective studies should be conducted to clarify the causal relationship between assignment of DHs to rehabilitation wards and rehabilitation outcomes.

The present study found that among stroke and hip fracture patients in rehabilitation wards to which a DH was assigned, ADL and swallowing function were significantly improved at discharge and the rate of home discharge was higher. This result suggests that the presence of a ward-assigned DH may lead to better prognosis among older people in rehabilitation wards. DHs should be utilized more widely in rehabilitation wards to provide holistic oral health care.

Acknowledgements: This work is supported by a grant from the Japan Society for the Promotion of Science (grant number: 18K10690). The authors would like to thank Atagawa Hospital, Nagasaki Rehabilitation Hospital, Miharu Hospital, Tsurumaki Onsen Hospital, Haradoi Hospital, Nanko Hospital, Nishi Hiroshima Rehabilitation Hospital, Yasuoka Hospital, Kanazawa Nishi Hospital, Sakurakai Medical Corporation Sakurakai Hospital, Sapporo Nishi-maruyama Hospital, Mihono Hospital, Tamana Regional Health Medical Center, Jikei University Daisan Hospital, Nakanoshima Iwaki Hospital, Nishinomiya Kyoritsu Neurosurgical Hospital, and Minamisoma Municipal General Hospital for providing patients' data to the JRND.

Disclosure statement: Hidetaka Wakabayashi received a grant from the Japan Society for the promotion of Science (grant number: 19H03979) outside the submitted work. Keisuke Maeda received a grant from the Japan Society for the promotion of Science (grant number: 18K11142) outside the submitted work. Other authors have no conflicts of interests.

Ethical standards: This study was approved by the ethics committee at the Jikei University School of Medicine (approval number 27-150 [8035]). This study has been performed in accordance with the ethical standards established in the 1964 Declaration of Helsinki and later amendments.

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