The factors associated with oral health related quality of life, treatment difficulty and frailty of patients requiring prosthodontic care in general dental practice

（地域歯科診療所における補綴治療を必要とする患者の口腔関連 QOL, フレイルおよび補綴歯科治療の難易度に関連する要因の検討）

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I. Abstract

Introduction

Prosthetic dentistry can improve patients' quality of life by restoring the morphological defect and the lost function. For this purpose, the dentist must understand the missing teeth, occlusion, and related functional problems to achieve this. In addition, in recent years, dentists have also been required to assess the patient's physical and mental state, aging problems and evaluate the patient before and after treatment. Older patients visiting general dental clinics have oral morphological and functional problems due to missing teeth and physical and psychological aging-related problems, such as multiple oral functional declines and frailty. However, research on patients who show up to the dental clinic with complaints is scarce. To aim of this was study was to clarify the patients' factors associated with oral health-related quality of life (OHRQoL), treatment difficulty, and frailty due to missing teeth in general dental practice.

Methods

Patients aged 65 years or older who visited a dental clinic (35 males and 48 females, mean age 74.0 ± 6.9 years) and needed prosthetic dentistry were included in this study. Oral status and oral function (i.e., number of teeth, oral hygiene, oral dryness, tongue/lip motor function, occlusal force, tongue pressure, subjective and objective masticatory

function, swallowing function, treatment hardness classification advocated by the Japanese Society of Prosthodontics) were evaluated. OHRQoL was evaluated by the Japanese version of the Oral Health Impact Profile 14 (OHIP-14). Status of frailty was evaluated by Kihon Checklist.

Results

The correlation coefficient between the OHIP-14 score and the subjective masticatory score showed a significantly negative correlation. There was also a significant negative correlation between psychological discomfort and oral moisture (-0.261, $p = 0.023$), and objective masticatory performance (-0.226, $p = 0.049$).

Among the patients who visited the community dental clinic requiring prosthodontic treatment, 71 (87.7%) were classified as having Oral Hypofunction. In the multivariate analysis, subjective masticatory function was a significant factor in treatment difficulty and frailty.

Conclusion

This study was got the following conclusion.

1) Seventy-one patients (87.7%) were classified as having poor oral function.

2) There was a correlation between OHRQoL and subjective masticatory function.

3) In the multivariate analysis, subjective masticatory function was a significant factor

in treatment difficulty and frailty.

II. Introduction

In addition to morphological problems, tooth loss reduces oral functions such as chewing and pronunciation. Furthermore, it has been reported that the decline in these oral functions can be a risk factor for requiring nursing care or death[1]. In Japan, the number of elderly people who maintain their teeth has increased due to behavioral changes caused by the "8020 Movement"[2], an oral health campaign, but many still require prosthodontic treatment with dentures[3].

Prosthetic dentistry can improve patients' quality of life by restoring the morphological defect and the lost function. For this purpose, the dentist must understand the missing teeth, occlusion, and related functional problems to achieve this. In addition, in recent years, dentists have also been required to assess the patient's physical and mental state, aging problems and evaluate the patient before and after treatment.

The evaluation of the treatment should be a combination of subjective and objective evaluation and evaluation by the patient. In recent years, the Japanese Society of Geriatric Dentistry has proposed a comprehensive evaluation of multiple oral functions, such as mastication, pronunciation, and swallowing, called "oral hypofunction (OHF)"[4]. In addition, the Japanese Society of Prosthodontics proposed a classification of disease types

that evaluates the degree of difficulty of treatment based on the number of teeth and the occlusal state, and the ridge morphology [5,6]. In addition, the questionnaire for oral health related quality of life (OHRQoL) has been widely used to evaluate various other aspects of oral health, including physical, functional, psychological, and social status [4,7-9].

Older patients visiting general dental clinics have oral morphological and functional problems due to missing teeth and physical and psychological aging-related problems, such as multiple oral functional declines and frailty. The decline in oral function and physical and mental function has been reported on older adults living in the community[1,7-10]—however, research on patients who show up to the dental clinic with complaints is scarce. In these settings, better results can be expected by assessing the oral function of elderly patients with physical and mental problems and tooth loss and reflecting these in prosthetic interventions.

Thus, this study investigated the patients' factors associated with oral health-related quality of life, treatment difficulty, and frailty due to missing teeth in general dental practice.

III. Materials and Methods

1. Study design

Cross-sectional study.

2. Participants

Patients aged 65 years or older who visited a dental clinic in Noda city, Japan, between January and December 2020, who were willing to receive removable prosthodontic treatment for edentate teeth and agreed to participate in the study were included. An evaluation of oral status and function, measurement of oral-related QoL, evaluation of frailty was conducted prior to the commencement of prosthodontic treatment. All investigations were conducted as part of the dental treatment process.

3. Surveyed items

1) Basic attributes

Age, gender, and medical history was obtained from medical records.

2) Evaluation of oral status and function

All evaluations were performed by one dentist with sufficient clinical experience in prosthodontics.

(1) Current number of teeth

The number of teeth was obtained from the medical records. Any remaining residual

tooth root was excluded from the measurement.

(2) Oral hygiene

Oral hygiene was evaluated visually using the Tongue Coating Index (TCI) [11].

(3) Oral dryness

Oral dryness was assessed using an oral moisture measure (Mucus, Life Co., Ltd, Saitama) to evaluate the level of wetness of the mucous membrane at the center of the dorsum of the tongue [12].

(4) Oral Diadochokinesis (ODK)

ODK evaluates the tongue/lip motor function was measured by pronouncing /pa/, /ta/, and /ka/ sounds for 5 seconds, and the number of times per second was recorded.

(5) Occlusal force

The occlusal force was measured by patients clenching teeth for 3 seconds at the central occlusal position using a pressure-sensitive sheet (Dental Prescale II, GC, Tokyo). The pressure-sensitive sheets were analyzed using a dedicated measuring instrument (Bite force Analyzer, GC, Tokyo) [13].

(6) Tongue pressure

Tongue pressure was evaluated by a tongue pressure measuring instrument (JMS tongue pressure measuring instrument TPM-01, JMS Co., Ltd, Hiroshima) [14].

Participants compressed the measurement balloon onto the palate for a few seconds with maximum pressure. The maximum tongue pressure was measured three times, and the average value was calculated.

(7) Masticatory function

Subjective and objective masticatory function were evaluated. Subjective masticatory performance was evaluated by the food intake questionnaire [15,16]. The obtained score was used as the “subjective masticatory score”.

The objective masticatory function was evaluated using gummy jelly. The amount of glucose eluted from the chewed gummy jelly chewed for 20 seconds was measured with a masticatory performance measuring device (Gluco Sensor GS-II, GC, Tokyo) [17]. The obtained value was used as the “objective masticatory performance”.

(8) Swallowing function

The swallowing function was measured using a subjective index. A self-administered questionnaire, the 10-item Eating Assessment Tool (EAT-10), assessed swallowing function [18].

The diagnosis of OHF was based on the following symptoms: TCI (≥50%), Oral dryness (<27), ODK (any of “pa”, “ta”, and “ka” sounds <6 times/s), Occlusal bite force (<500 N), Tongue pressure (<30 kPa), Masticatory function (<100 mg/dL), Swallowing

function (≥3 points). A score of 1 was assigned to the case and a score 3 or more was considered as OHF.

3) Measurement of oral-health related Quality of Life

Oral-health related Quality of Life (OHRQoL) was measured using the Japanese version of the Oral Health Impact Profile (OHIP-14) [19]. The OHIP-14 contains seven dimensions: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap, and consists of 14 questions. Each item is answered on a 5-point Likert scale from 0 to 4, where 0="not applicable" or "never," 1="hardly ever," 2="occasionally," 3="often," and 4="very often." A higher total score reflects a worse OHRQoL rating.

4) Treatment difficulty's classification of prosthodontic treatment

The study subjects with complete or partially missing teeth were classified into four levels (levels 1 to 4) based on the morphological status of the oral cavity proposed by the Japanese Society of Prosthodontics [5,6]. In summation, levels 1 and 2 were classified as "basic case groups," and levels 3 and 4 were classified as "difficult case groups."

5) Evaluation of frailty

Following Satake et al.[20], frailty was assessed using the Kihon Checklist (KCL), which determines the level of need for support and care for the Japanese elderly. The KCL

is divided into the following seven domains: instrumental activities of daily living (IADL), body, nutrition, food, social participation, memory, and depression, and the total KCL score can be obtained by summing the answers of KCL [21]. A total KCL score of 8 or higher was considered to indicate frailty.

4. Statistical analysis

The correlations between the oral status, oral function, and OHRQoL were analyzed by Spearman's correlation coefficient, and a *P* value of less than 5% was considered statistically significant.

Comparative analysis was performed by the Mann-Whitney U-test to examine continuous variables between the groups, and the chi-square test was conducted to examine categorical variables between the classification of difficulty (basic and difficult groups) and the presence or absence of frailty (frailty or non-frailty groups).

The factors associated with oral function were analyzed using binomial logistic analysis.

All statistical analyses were performed using SPSS version 23.0, for Windows (IBM Corp., Armonk, NY, USA). The statistical significance was set at 5%.

5. Ethical considerations

This study was conducted with the approval of the Ethics Committee of Nihon

University School of Dentistry at Matsudo (EC20-040A, 040 B) and in accordance with the Declaration of Helsinki. Informed consent was obtained from all subjects.

IV. Results

1. Basic characteristics of the participants

The participants who met the inclusion criteria and consent was obtained from 83 subjects (35 males and 48 females, mean age 74.0 ± 6.9 years). Among these participants, one patient who could not respond to the questionnaire and six patients who did not respond to one or more tests were excluded from the analysis of correlations between the oral status and OHRQoL Finally, 76 subjects were analyzed (32 males and 44 females, mean age 74.4 ± 6.8 years). For the analysis of factors related to the treatment difficulty and frailty, two subjects could not undergo examination of all the required items were excluded and 81 subjects were analyzed (35 males and 46 females, mean age 73.8 ± 6.9 years).

2. Basic attributes, oral status, and function and OHRQoL (Table 1)

The results of the measurement items of the subjects are shown in Table 1. Seventy-one subjects (87.7%) were classified as having OHF. The mean number of the remaining teeth (13.4 ± 7.5) and the mean score of OHIP-14, which represented the OHRQoL was 9.5 ± 8.0 points.

3. The relations between OHRQoL and oral status and function items (Table 2)

The correlation coefficient between the OHIP-14 total score and the subjective masticatory score showed a significantly negative correlation (-0.352, p = 0.002). Subjective masticatory score showed most of the sub-domain of OHIP-14 items: Physical pain (-0.287, p = 0.012), Physical disability (-0.309, p = 0.007), Psychological disability (-0.386, p = 0.001), Social disability (-0.231, p = 0.045) and Handicap (-0.303, p = 0.008), respectively. Significant negative correlation was detected between psychological discomfort and oral moisture (-0.261, p = 0.023) and objective masticatory performance (-0.226, p = 0.049).

4. Comparative analysis of basic attributes, oral status, and function between treatment difficulty, frailty, and oral function (Table 3 and 4)

Tables 3 and 4 show the results of oral function in terms of treatment difficulty and the presence of frailty in prosthetic dentistry. Forty-one patients (51.0%) were classified as easy and 40 patients (49.0%) as difficult. The items that were significantly lower in comparison to the items measured in treatment difficulty were gender (p = 0.044), the number of remaining teeth (p < 0.001), bite strength (p < 0.001), objective masticatory ability (p < 0.001), masticatory score (p = 0.002), and oral hypofunction (p = 0.007).

Those classified as robust and pre-frail in the presence or absence of frailty were 57

(66.6%) and 24 (33.3%), respectively. The items with significantly lower values than those without frailty were age (p=0.026) and chewing score (p=0.010).

5. Multivariate analysis of oral functions related to frailty and difficulty of treatment

Tables 5 and 6 show the results of the binomial logistic regression analysis. The difficulty of treatment and the presence of frailty were the objective variables. The explanatory variables were the items which showed significant differences in the comparative analysis. The analysis revealed that the subjective masticatory score (p=0.012, OR: 0.95, 95% CI: 0.92 - 0.99) was extracted as a factor related to treatment difficulty. For the factors related to frailty, age (p = 0.021, OR: 1.101, 95% CI: 1.015–1.195) and subjective masticatory score (p = 0.005, OR: 0.949, 95% CI: 0.915–0.984) were significant.

V. Discussion

This study investigated the patients' factors associated with oral health-related quality of life, treatment difficulty, and frailty of the patient with missing teeth and need of prosthetic treatment in general dental practice. The result indicated a significant correlation between the total score of OHRQoL and the subjective masticatory score. Also, the subdomains of OHRQoL, physical pain, physical disability, psychological disability, social disability, and handicap, correlated with the subjective masticatory score. Psychological discomfort is also correlated with oral moisture and objective masticatory

performance. In addition, the factors associated with frailty and morphological difficulty and oral status and oral functions were age and the subjective masticatory score. Likewise, the subjective masticatory score was cited as a factor related to case difficulty.

The subjects of this study were patients visiting a local dental clinic. Previous research subjects have been mainly older adults living in the community and patients at university hospitals who participated in health surveys [22-26], and these subjects may have a high perception of oral health. However, the present study subjects were further limited to patients who needed prosthetic treatment due to missing teeth. In addition, older adults are more likely to require treatment due to missing teeth. Therefore, the results of this study may reflect more clearly the problems of patients who visit the dental clinic.

In this study, multiple oral functions were subjectively and objectively assessed. A masticatory function was assessed subjectively and objectively. It has been reported that a decline in multiple oral functions is a risk factor for sarcopenia, frailty, need for nursing care, and death[22,23]. Based on these findings, we believe that assessing multiple oral functions may be helpful in better identifying oral-related problems and restoring oral function. Reports have been assessing multiple oral functions in older adults living in the community[23-25].

On the other hand, the oral functions of the subjects in the present study were lower

than those in these previous studies[24,26]. Since the subjects in the present study were older adults who required prosthetic dentistry, who had specific problems due to tooth loss. Therefore, it is reasonable that study subjects' oral function was lower than the older adults living in the community.

In the present study, no correlation was found with the total OHIP score, and a weak significant correlation was found with the subdomain Psychological Discomfort. A previous study reported an association between OHRQoL and oral mucosal moistness and oral diadochokinesis as assessed by the Geriatric Oral Health Assessment Instrument (GOHAI) in young adults [27]. In previous studies OHRQoL and xerostomia have been found to be related [28]. The impact of xerostomia on oral health-related quality of life is also supported by the results of this study. Additionally, regarding the relationship between objective masticatory function and discomfort, it has been reported that treatment of missing teeth improves masticatory function and OHRQoL [3]. A systematic review of previous studies reported that tooth loss was associated with impaired OHRQoL regardless of the location of tooth loss [29]. Due to the syndromes secondary to neglected tooth loss, the decline in oral function may be accelerated and related to the impairment of OHRQoL.

This study evaluated the difficulty of treatment owing to the morphological conditions

of the oral cavity [5,6]. Morphological examination can determine the difficulty of prosthetic dentistry, such as the number of teeth, the occlusal condition, and the condition of the mucosa of the jaw crest. To the best of our knowledge, no studies have examined the relationship between morphological difficulty and oral function. Knowing the relationship between oral conditions other than the number of teeth and oral function is necessary to improve the predictability of treatment. However, the assessment of treatment difficulty encompasses the morphological status of the oral cavity and the physical, social, and psychological status. It was difficult to assess all of these factors in this study. To compare the various conditions of the patients, this study examined the association with frailty.

In this study, the KCL was used as a measure of frailty. There are various ways to assess frailty [20,30,31]. The KCL defines a vulnerable state susceptible to disability due to trivial stress caused by a decline in physical and mental functions [32-35]. The KCL is a questionnaire-based assessment, it can be easily administered to general dental practitioners. Therefore, assessing frailty using the KCL in dental practice may help understand various situations in older adults. In this study, 29.6% of the subjects were classified as frailty. This percentage was considerably higher than that reported in previous studies [22,36]. The previous study objective masticatory function and

subjective masticatory ability were associated with the progression of frailty [37]. Onuki et al. reported that the results of oral function tests could be easily influenced by dental complaints [38]. Therefore, it is possible that many patients with decreased oral function, including masticatory function, increased the number of those who fell into the frailty category.

The masticatory score, which evaluates subjective masticatory function, was extracted as an oral function associated with frailty and difficulty of treatment, even after adjusting for other factors. Conversely, objective masticatory function using glucose elution, was no association when other factors were adjusted. In previous studies, masticatory function, bite strength, and masseter muscle thickness have been identified as oral functions related to frailty [22,37]. Treatment difficulty is a factor encompassed by the number of teeth and the occlusal status [5,6]. Occlusal status has been reported to be a factor related to masticatory function[39]. The results of this study also support these findings to some extent. Also, it is necessary to consider a combination of subjective and objective evaluations when grasping the actual situation of mastication [40]. The gummy jelly used by objective evaluation, is hard and elastic; therefore, it may have been difficult to chew in patients with missing teeth, thus weakening the association. The state of missing teeth and the state of wearing and fitting dentures, if worn, of the subjects in this study varied.

Furthermore, it has been reported that subjective and objective assessments of masticatory function vary depending on physical and mental conditions [41,42]. The difference in oral-related QOL between subjective and objective masticatory function in this study may be due to the difference in defect status. Also, it was considered that there were differences in the results between subjective and objective masticatory function evaluations in both frailty and treatment difficulty. There are no previous reports on the evaluation of oral function at the treatment difficulty level. Moreover, since the subjects were patients with missing teeth and their situations varied, the floor effect may have affected the results of objective masticatory function. Future studies should be conducted with a more significant number of subjects.

The subjects of this study were those who needed prosthetic dental treatment due to missing teeth. The number of subjects in this study was not enough to examine the differences due to various tooth deficiencies. Therefore, it is necessary to conduct a survey that reflects various defect conditions in the future. Also, this study was done as part of the insurance treatment in Japan. Therefore, subjects under 65 years old were excluded from the study because it was not possible to evaluate oral function. This limitation of the target population may have biased the results of this study.

However, many elderly Japanese patients still require prosthetic dentistry such as

dentures [43]. This study clarified the relationship between oral function, physical and mental status, and oral status of elderly patients who need prosthetic dentistry. The results of this study may provide an opportunity to review the policy of dental treatment for the elderly in the future.

VI. Conclusions

Among the patients who visited the community dental clinic needing prosthodontic treatment, this study led to the following conclusions:

1) Seventy-one patients (87.7%) were classified as having poor oral function.

2) There was a correlation between OHRQoL and subjective masticatory function.

3) In the multivariate analysis, subjective masticatory function was a significant factor in treatment difficulty and frailty.

Patients who needed prosthetic treatment visiting the dental clinic may have various subjective problems and poor oral function. Dentists should evaluate the oral function and subjective assessment of patients before prosthodontic treatment. Also, it is necessary to note that patients who need treatment for missing teeth may complain of subjective masticatory difficulty due to their oral and physical conditions.

VII. References

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VIII. Tables and Figures

Table 1. Distribution of oral function and oral-related quality of life (n = 76)

	Mean	SD	Median	IQR
Age	74.4	6.8	73	8.8
Number of teeth	13.4	7.5	15	11
Tongue Coating Index (%)	52	21.1	55.6	27.8
Oral moisture	26.6	2.7	26.9	3.5
ODK/pa/ (time/s)	5.6	1	5.7	1.4
ODK/ta/ (time/s)	5.4	1.1	5.6	1.2
ODK/ka/ (time/s)	5.1	1.1	5.3	1.2
Occlusal force (N)	402.3	273.4	334.6	334.1
Tongue pressure(kPa)	28	9	29.3	10.6
(subjective) masticatory score	86.1	17.1	91.6	23.7
(objective) masticatory performance(mg/dL)	97	48.9	87.5	60.8
EAT-10 score	0.8	2.1	0	1
OHIP-14 score	9.5	8	8	12.8
functional limitation	1.7	1.6	2	3
physical pain	1.6	1.6	1.5	2
psychological discomfort	1.6	1.5	2	2
physical disability	1.1	1.2	1	2
psychological disability	1.2	1.5	0	2
social disability	1.1	1.3	1	2
Handicap	1.3	1.5	1	2

ODK: Oral Diadochokinesis
EAT-10: 10-item Eating Assessment Tool
OHIP: Oral Health Impact Profile.
SD: Standard Deviation
IQR: Interquartile Range

Table 2. The relations between OHRQoL and oral status and function items.

	Functional limitation	Physical pain	Psychological discomfort	Physical disability	Psychological disability	Social disability	Handicap	OHIP-14 score
Age	-0.082	0.083	-0.087	-0.107	0.008	-0.049	0.062	-0.015
Sex	-0.031	0.136	0.207	0.118	0.07	0.082	0.039	0.114
Number of natural teeth	-0.089	-0.166	-0.124	0.055	0.068	0.089	0.049	-0.053
Tongue Coating Index	-0.062	-0.024	0.026	-0.025	0.030	0.036	0.064	0.029
Oral moisture	-0.166	-0.048	**-0.261***	-0.097	-0.020	-0.111	-0.058	-0.135
ODK /pa/ sounds	-0.014	-0.019	-0.046	-0.033	-0.007	0.014	-0.006	-0.044
ODK /ta/ sounds	0.044	-0.044	0.000	-0.011	0.014	-0.002	0.063	-0.007
ODK /ka/ sounds	0.066	0.007	-0.018	-0.051	-0.022	-0.013	-0.013	-0.030
Occlusal force	-0.133	-0.215	-0.193	-0.063	-0.031	0.006	0.027	-0.134
Tongue Pressure	0.188	-0.134	0.100	0.018	0.046	0.073	-0.110	0.016
Subjective masticatory score	-0.213	**-0.287***	-0.184	**-0.309***	**-0.386***	**-0.231***	**-0.303***	**-0.352***
Objective masticatory performance	0.029	-0.110	**-0.226***	0.000	-0.001	-0.025	0.052	-0.070
EAT-10 score	0.139	0.118	0.068	-0.026	0.092	0.034	0.034	0.083

ODK: Oral Diadochokinesis
EAT-10: 10-item Eating Assessment Tool
OHIP, Oral Health Impact Profile
*$p < 0.05$

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Table 3. Comparative analysis of basic attributes, oral status, and function between the treatment difficulty

	Easy (N=41)				Difficult (N=40)				
	Mean	SD	Median	IQR	Mean	SD	Median	IQR	p-value
Age, year,	74.9	± 6.0	73	(8.5)	72.9	± 7.5	70.0	(9.5)	0.071
Sex (woman), n (%)	19	(46.3%)	19	(46.3%)	28	(68.3%)	28	(68.3%)	0.044*
Medical history (presence), n (%)									
Heart disease	3	(7.3%)	3	(7.3%)	6	(14.6%)	6	(14.6%)	0.241
Aspilation pneumonia	1	(2.4%)	1	(2.4%)	2	(4.9%)	2	(4.9%)	0.500
Diabetes mellitus	7	(17.1%)	7	(17.1%)	6	(14.6%)	6	(14.6%)	0.762
High blood pressure	14	(34.1%)	14	(34.1%)	19	(46.3%)	19	(46.3%)	0.260
Cerebrovascular disorder	2	(4.9%)	2	(4.9%)	3	(7.3%)	3	(7.3%)	0.500
Number of teeth present,	15.9	± 8.1	18	(11.0)	10.1	± 5.1	9.0	(9.0)	<0.001*
Number of teeth denture,	8.3	± 10.0	4	(14.0)	11.2	± 8.6	14.0	(19.0)	0.070
TCI score	47.6	± 22.2	55.6	(36.1)	56.5	± 18.5	61.1	(30.6)	0.202
Oral dryness,	27.0	± 2.4	27.3	(2.4)	26.2	± 3.0	26.5	(3.8)	0.339
Occlusal force, N,	496.1	± 303.7	431.4	(443.4)	292.4	± 182.5	258.1	(261.7)	0.001*
ODK /pa/, time/s	5.6	± 1.0	5.6	(1.6)	5.5	± 1.1	5.6	(1.2)	0.784
ODK /ta/, time/s	5.3	± 1.2	5.6	(1.1)	5.3	± 1.0	5.6	(1.3)	0.823
ODK /ka/, time/s	5.0	± 1.2	5.2	(1.2)	5.2	± 1.0	5.4	(1.4)	0.583
Tongue pressure, kPa,	28.6	± 7.3	29.3	(10.4)	28.2	± 12.1	29.3	(12.2)	0.731
Masticatory performance, mg/dl,	113.2	± 50.3	103	(65.5)	72.9	± 39.8	67.0	(58.0)	<0.001*
EAT-10,	1.0	± 2.6	0	(1.0)	1.0	± 2.3	0.0	(1.0)	0.987
Number of oral function decline items,	3.6	± 1.5	4	(2.0)	4.5	± 1.1	4.0	(1.0)	0.014*
Oral hypofunction (presence), n (%)	32	(78.0%)	32	(78.0%)	40	(97.6%)	40	(97.6%)	0.007*
Subjectory masticatory score	91.1	± 13.3	96.6	(18.0)	78.2	± 19.1	79.6	(29.6)	0.002*

TCI, Tongue Coating Index
ODK, Oral Diadochokinesis
EAT-10, 10-item Eating Assessment Tool
SD, Standard Deviation
IQR, Interquartile Range
*, $p < 0.05$

Table 4. Comparative analysis of basic attributes, oral status, and function between the presence and absence of frailty

	Robust and pre-frail (N=57)				Frail (N=24)				
	Mean	SD	Median	IQR	Mean	SD	Median	IQR	*p*-value
Age, year,	72.7 ±	6.4	72.0 (	9.0)	76.6 ±	7.3	84.0 (	14.0)	0.026*
Sex (woman), n (%)	30 (	52.6%)	30 (	52.6%)	16 (	66.7%)	(	66.7%)	0.244
Medical history (presence), n (%)									
Heart disease	5 (	8.8%)	5 (	8.8%)	4 (	16.7%)	(	16.7%)	0.252
Aspiration pneumonia	3 (	5.3%)	3 (	5.3%)	0 (	0.0%)	(	0.0%)	0.343
Diabetes mellitus	9 (	15.8%)	9 (	15.8%)	4 (	16.7%)	(	16.7%)	0.580
High blood pressure	22 (	38.6%)	22 (	38.6%)	11 (	45.8%)	(	45.8%)	0.358
Cerebrovascular disorder	3 (	5.3%)	3 (	5.3%)	2 (	8.3%)	(	8.3%)	0.467
Number of teeth present,	14.1 ±	7.1	16.0 (	11.0)	10.8 ±	7.6	16.8 (	12.5)	0.088
Number of teeth denture,	8.5 ±	8.9	7.0 (	16.0)	12.5 ±	10.0	20.0 (	17.8)	0.093
TCI score	50.8 ±	21.1	55.6 (	25.0)	54.6 ±	20.6	72.2 (	37.5)	0.414
Oral dryness,	26.5 ±	2.8	26.8 (	3.2)	27.2 ±	2.4	29.4 (	4.5)	0.339
Occlusal force, N,	445.5 ±	282.5	392.5 (	335.0)	295.3 ±	226.5	363.7 (	217.8)	0.010*
ODK /pa/, time/s	5.6 ±	0.9	5.6 (	1.6)	5.4 ±	1.3	6.4 (	1.3)	0.938
ODK /ta/, time/s	5.4 ±	1.0	5.4 (	1.2)	5.0 ±	1.4	6.0 (	1.4)	0.392
ODK /ka/, time/s	5.2 ±	0.9	5.4 (	1.2)	4.8 ±	1.4	5.8 (	1.4)	0.335
Tongue pressure, kPa,	29.1 ±	9.1	29.7 (	10.3)	26.5 ±	11.8	33.3 (	13.9)	0.341
Masticatory performance, mg/dl,	94.8 ±	48.4	87.0 (	66.5)	91.6 ±	52.4	117.8 (	57.8)	0.549
EAT-10,	0.9 ±	2.6	0.0 (	1.0)	1.2 ±	2.2	1.8 (	1.8)	0.186
Number of oral function decline items,	3.9 ±	1.5	4.0 (	2.0)	4.3 ±	1.2	5.0 (	1.8)	0.450
Oral hypofunction (presence), n (%)	49 (	86.0%)	49 (	86.0%)	22 (	91.7%)	(	91.7%)	0.341
Subjective masticatory score	88.1 ±	15.4	96.0 (	23.2)	75.9 ±	19.9	88.4 (	19.0)	0.006*

TCI, Tongue Coating Index
ODK, Oral Diadochokinesis
EAT-10, 10-item Eating Assessment Tool;
SD, Standard Deviation
IQR, Interquartile Range
*, $p < 0.05$

Table 5. Factors associated with treatment difficulty in multivariate analysis

	Multivariable analyses		
	OR	95% CI	*p*-value
Sex (0 = female, 1 = male)	0.41	[0.11 - 1.56]	0.190
Number of teeth present (per one increase)	0.95	[0.87 - 1.03]	0.215
Occlusal force (per one increase)	1.00	[1.00 - 1.00]	0.637
Masticatory performance (per one increase)	1.01	[0.99 - 1.02]	0.317
Oral hypofunction (0 = absence, 1 = presence)	1.08	[0.58 - 2.02]	0.813
Subjective masticatory score (per one increase)	0.95	[0.92 - 0.99]	0.012*

OR: Odds ratio
CI: Confidence interval

Table 6. Factors associated with the presence of frailty in multivariate analysis

	Multivariable analyses		
	OR	95% CI	*p*-value
Age (per one increase)	1.10	[1.02 - 1.20]	0.021*
Occlusal force (per one increase)	1.00	[1.00 - 1.00]	0.360
Subjective masticatory score (per one increase)	0.95	[0.91 - 0.98]	0.005*

OR: Odds ratio
CI: Confidence interval