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Original

Association between Motivation Scale Score and Oral Condition on Receiving Basic Periodontal Therapy

Ai SAKUMA[1,2], Makoto FUKUI[1], Yukio ASO[2] and Daisuke HINODE[1]

Abstract: The purpose of this study was to evaluate the usefulness of the motivation scale score (MSS) for Japanese adults and investigate motivation related to the oral condition on receiving basic periodontal therapy using MSS.

The participants enrolled in this study were 221 patients with periodontal disease aged 20-64 years who visited a dental clinic in Shizuoka City, Japan for the first time. MSS was calculated using a 14-item-questionnaire concerning the patients' motivation assessment scale, and principal component analysis of MSS was performed. The associations among MSS, items of oral health behavior, periodontal conditions [Bleeding on probing (BOP) rate, Periodontal inflamed surface area (PISA)], and oral hygiene status [O'Leary's Plaque control record (PCR)] were evaluated at the baseline and after basic periodontal treatment.

MSS was shown to be useful in terms of reliability and validity and was classified into five factors. MSS and MSS-Factor 1 (oral hygiene practices) of participants with BOP of less than 10% were significantly higher than in of participants with BOP of more than 10% at the baseline. In addition, MSS and MSS-F1 were significantly higher among participants who received regular dental check-ups within a year and used interdental cleaning tools. MSS-F1 was significantly higher in non-smokers. By binominal logistic regression analysis, the use of interdental cleaning tools was significantly correlated with BOP of less than 10% at the baseline. All items related to oral conditions and oral health behavior improved after basic periodontal therapy, except for current smoking status. After basic periodontal therapy, MSS was significantly higher in participants with PCR of less than 20%, and MSS-F1 was significantly higher in participants who used interdental cleaning tools or were non-smokers.

It was revealed that MSS used in this study was useful and associated with the periodontal condition and oral health behavior at the baseline. The values of MSS and MSS-F1 significantly increased after basic periodontal therapy. The use of interdental cleaning tools was associated with a good oral condition and higher MSS. Therefore, high motivation might lead to a good oral condition in patients with periodontal disease through the use of interdental cleaning tools by influencing patients' compliance to improve their oral health behaviors.

Key words: **Motivation scale score, Basic periodontal therapy, Oral health behavior, Interdental cleaning tools**

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Introduction

Japan now has a super-aged society, and the field of dentistry aims to maintain and improve oral functions by increasing the number of remaining teeth, which will lead to an increase in healthy life expectancy. However, when the number of remaining teeth increase, oral problems like tooth decay and periodontal disease also increase. Periodontal disease is the leading cause of tooth loss in adults, and the proportion of residents with periodontal pockets of 4 mm or more increases with age*1. Periodontal disease has also been reported

[1] Department of Hygiene and Oral Health Science, Tokushima University Graduate School of Biomedical Sciences
[2] Aso Dental Clinic

*1 Ministry of Health, Labour and Welfare: Survey of Dental Diseases. 2016. Available online, https://www.mhlw.go.jp/toukei/list/dl/62-28-02.pdf (accessed on 21 July 2023). (In Japanese)

to be associated with various systemic diseases[1-5]. Early treatment of periodontal disease is considered necessary because the onset of periodontal disease and increase in tooth loss may lead to a decline in the oral function.

Patients' motivation is essential to promote oral health and important for the long-term maintenance of oral health during periodontal treatment, but this is often difficult to sustain. Motivation is the force acting either on or within a person to initiate behavior. Motivation in dental treatment is considered to play a major role in influencing dental health behavior[6-8]. In dental health guidance, differences in effectiveness were observed in patient education methods for motivation and decision-making to change behavior, but the association between the pathophysiology of periodontal disease and dental health behavior and knowledge about periodontal disease was weak[9]. It was also reported that passive accumulation of knowledge by target subjects, such as through lectures and explanations, was unlikely to lead to behavior change[10].

On the other hand, personal health guidance, including practical skills instruction, had the ability to improve oral hygiene behavior[11]. These results indicate that individual dental health guidance is necessary to enhance motivation and change health behavior. It may be useful for dental professionals to investigate the effect of motivation for improvement of the periodontal status as evidence of basic periodontal treatment in patients with periodontal disease.

Few studies have focused on the role of motivation in dental treatment. Pac et al.[12] showed that the motivation scale score (MSS) was an accurate tool for evaluation of the motivation of patients with periodontal diseases. Oruba et al.[13] showed that MSS was correlated with periodontal conditions such as the bleeding on probing (BOP) score and community periodontal index for treatment needs (CPITN) in addition to approximal plaque index.

The purpose of this study was to evaluate the usefulness of MSS for Japanese adults and investigate motivation related to the oral condition in patients with periodontal disease before and after basic periodontal therapy using MSS.

Methods

1. Study design and participants

The participants enrolled in this study were first-visit patients with periodontal disease aged 20-64 years who visited Aso Dental Clinic in Shizuoka City, Japan between January 2020 and November 2021. As shown in Figure 1, oral examination, evaluation of MSS, and a questionnaire survey related to oral health behavior were conducted at the baseline. Then, basic periodontal therapy including oral health instruction (OHI) and periodontal treatment was performed. After basic periodontal therapy, oral examination, evaluation of MSS, and the questionnaire survey related to oral health behavior were conducted again. Among 252 patients at the baseline, 221 patients (male patients: 73, female patients: 148, mean age: 38.2±10.9 years) who continued to visit the dental clinic after basic periodontal treatment were selected as the final participants in this study.

2. Clinical parameters assessed by oral examination

Informed consent of each patient was obtained at the first visit after explaining the necessity of oral examination to determine the cause of a disease. At the baseline and after basic periodontal treatment, periodontal examination was performed at 6 points per tooth using a periodontal probe, while the percentage of bleeding on probing (%BOP) and Periodontal Inflamed Surface Area (PISA) were measured[14]. In addition, O'Leary's Plaque Control Record (PCR)[15] was measured to assess oral hygiene conditions. Evaluation categories of clinical parameters were determined by reference, as follows: BOP (BOP≥10%/BOP<10%)[16],

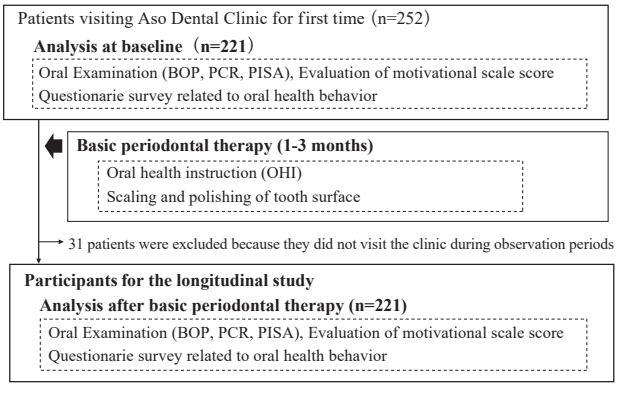

Figure 1 Flow diagram of this study

Table 1　The motivation scale adjusted for assessing motivation among periodontal patients

Item	Response scale limits, scored 1-5
Q1. How often do you undergo professional oral hygiene care (scaling)?	never-more than once every few months†
Q2. Did you undergo periodontal treatment willingly?	definitely no - definitely yes
Q3. Do you find periodontal treatment particularly difficult?	definitely yes - definitely no
Q4. How many times a week do you perform oral hygiene self-care sessions according to the recommendations given by a dentist?	rarely - at least 3 times a day†
Q5. How much time do you spend on performing one oral hygiene self-care session?	none - more than 5 minutes†
Q6. Do you clean your teeth carefully after professional cleaning (scaling) performed by a dentist or dental hygienist?	definitely no - definitely yes
Q7. Did you adhere to the recommendations that were supposed to alleviate the symptoms of periodontal disease?	definitely no - definitely yes
Q8. Do you think you need periodontal treatment?	definitely no - definitely yes
Q9. How has the periodontal treatment you received so far influenced the symptoms of periodontal disease?	no effects - definitely good effects
Q10. Do you find professional cleaning and oral hygiene self-care pleasant?	definitely no - definitely yes
Q11. Does your general health condition allow you to undergo periodontal treatment?	definitely no - definitely yes
Q12. How do you find the cooperation with the periodontal team?	definitely bad - definitely good
Q13. Have there been any unpleasant incidents in your personal life or in your family during periodontal treatment?	definitely yes - definitely no
Q14. How far from your home is the periodontal practice that you attend?	very long distance - very short distance

Note that items 3 and 13 were reverse coded
†: The scale was modified from the original reference[12]

PCR (PCR≥20%/PCR<20%)[15, 17], and PISA (PISA≥130.33 mm^2/PISA<130.33 mm^2). The cut-off point of PISA was decided as 130.33 mm^2, which is an average score after basic periodontal therapy[18].

Oral examination and basic periodontal therapy were performed by 2 dentists and 7 dental hygienists, and data were collected. Regarding the calibration of oral examinations, dental hygienists had received more than a year of training using manuals on oral examinations and basic periodontal treatment after joining a dental clinic. After reaching a certain level of skill, they started to treat patients using the same methods and procedures. We analyzed the values of measurements among the seven dental hygienists using dental models for measuring periodontal pockets, and oral photographs after BOP and PCR measurements. Fleiss' kappa coefficients for the values of periodontal pockets, BOP, and PCR were 0.941, 0.902, and 0.896, respectively, confirming that there was high inter-examiner agreement among the seven dental hygienists.

3. Questionnaire related to motivation scale score and oral health behavior

The questionnaire for MSS, which was reported by Pac et al.[12], was used in this study with slight modification (Table 1). This included a 14-item scale regarding various aspects of a patient's motivation for periodontal treatment, and a motivation score was calculated on a scale from 1 to 5 for each item, with a maximum score of 70 points. It was reported to be a reliable and accurate tool for evaluating motivation in patients with periodontal disease[12]. Items 1, 4 and 5 were changed to reflect the current situation in Japan. Completed questionnaires were obtained from the participants at the baseline and after basic periodontal therapy.

The contents of the questionnaire related to oral health behavior are shown in Table 2. Items of the questionnaire regarding knowledge of oral health management and attitude to regular dental check-ups were included. The use of fluoride, xylitol, and chlorhexidine was recommended to minimize the risk of dental car-

Table 2 Relationship between clinical parameters and oral health behaviors at the baseline

Item	Category	Sub-total	BOP			PISA			PCR		
			<10%	≥10%	p-value[#]	<130.33 mm^2	≥130.33 mm^2	p-value[#]	<20%	≥20%	p-value[#]
Sex	Male	73	11 (15.1)	62 (84.9)	0.037 *	7 (9.6)	66 (90.4)	0.016 *	4 (5.5)	69 (94.5)	0.587
	Female	148	41 (27.7)	107 (72.3)		34 (23.0)	114(77.0)		11 (7.4)	137 (92.6)	
Age	29-39	129	29 (22.5)	100 (77.5)	0.663	23 (17.8)	106 (82.2)	0.743	5 (3.9)	124 (96.1)	0.014 *
	40-64	92	23 (25.0)	69 (75.0)		18 (19.6)	74 (84.4)		10 (10.9)	82 (89.1)	
Regular dental check-ups within a year	Yes	82	27 (32.9)	55 (67.1)	0.011 *	23 (28.0)	59 (72.0)	0.005 **	10 (12.2)	72 (87.8)	0.014 *
	No	139	25 (18.0)	114 (82.0)		18 (12.9)	121 (87.1)		5 (3.6)	134 (96.4)	
Use of interdental cleaning tools	Every day	66	27 (40.9)	39 (59.1)	<0.001 **	19 (28.8)	47 (71.2)	0.018 *	10 (15.2)	56 (84.8)	0.005 **
	Sometimes	78	13 (16.7)	65 (83.3)		14 (17.9)	64 (82.1)		3 (3.8)	75 (96.2)	
	Never	77	12 (15.6)	65 (84.4)		8 (10.4)	69 (89.6)		2 (2.6)	75 (97.4)	
Frequency of eating between meals	Sometimes or never	66	16 (24.2)	50 (75.8)	0.870	12 (18.2)	54 (81.8)	0.926	6 (9.1)	60 (90.9)	0.374
	Once or more	155	36 (23.2)	119 (76.8)		29 (18.7)	126 (81.3)		9 (5.8)	146 (94.2)	
Current smoking status	No	193	48 (24.9)	145 (75.1)	0.217	38 (19.7)	155 (80.3)	0.254	13 (6.7)	180 (93.3)	0.936
	Yes	28	4 (14.3)	24 (85.7)		3 (10.7)	25 (89.3)		2 (7.1)	26 (92.9)	
Use of fluoride[a]	Yes	200	48 (24.0)	152 (76.0)	0.611	38 (19.0)	162 (81.0)	0.592	14 (7)	186 (93.0)	0.698
	No	21	4 (19.0)	17 (81.0)		3 (14.3)	18 (85.7)		1 (4.8)	20 (95.2)	
Use of chlorhexidine[b]	Yes	10	4 (40.0)	6 (60.0)	0.209	5 (50.0)	5 (50.0)	0.009 **	1 (10.0)	9 (90.0)	0.679
	No	211	48 (22.7)	163 (77.3)		36 (17.1)	175 (82.9)		14 (6.6)	197 (93.4)	
Use of xylitol[c]	Yes	9	2 (22.2)	7 (77.8)	0.925	1 (11.1)	8 (88.9)	0.558	2 (22.2)	7 (77.8)	0.06
	No	212	50 (23.6)	162 (76.4)		40 (18.9)	172(81.1)		13 (6.1)	199 (93.9)	

[a]: Fluoride toothpaste, [b]: Mouthrinse containing chlorhexidine, [c]: Chewing gum containing xylitol
The value means the number of participants, and the value in parentheses means its percentage.
[#]Chi-square test, $^*p<0.05$, $^{**}p<0.01$.

ies and periodontal disease in the dental clinic. Their regular use by patients was considered to be associated with behavioral changes related to oral health; therefore, these items were also included.

4. Basic periodontal therapy

Based on the results of a medical interview and dental examination, a treatment plan was formulated by the dentist and a personalized preventive plan was devised by the dental hygienist. As shown in Figure 1, we explained the necessity of using dental floss or interdental brushes and provided practical training as oral hygiene instruction (OHI) for about 10-20 minutes, and preventive treatment, including scaling and tooth polishing, were conducted for approximately 1 to 3 months to improve the oral environment during the treatment period. Although the interval between visits varied depending on each individual's periodontal condition, patients visited the clinic 1 to 7 times before re-evaluation.

5. Statistical analysis

Evaluation of MSS was performed by the method of Pac et al.[12]. Reliability analysis was conducted to assess the scale's internal consistency by calculating Cronbach's alpha[19]. While Cronbach's alpha rates the association between the items themselves, Pearson's correlations were computed to assess the item's correlations with the scale as a whole, and therefore, the homogeneity of the scale. In addition, for each item, Cronbach's alpha, after removal of that item, was inspected to find out if the exclusion changed the reliability of the scale.

Factor analysis was used to investigate the variation and covariation among the items. Principal component analysis was aimed at making an initial decision about the number of factors underlying a set of measures. Varimax rotation was used to achieve a simple structure with each item loading on as few dimensions as possible. Factors were extracted according to inspection of a scree plot and having a Kaiser criterion eigenvalue greater than one. Eigenvalues indicate the amount of variance of all factors explained by that factor, with greater eigenvalues accounting for more of the variance.

Regarding the baseline study, chi-square tests were performed to assess the association between oral health behaviors and clinical parameters (BOP, PISA, and PCR). Furthermore, binomial logistic regression analysis was performed using the two categories of clinical parameters as dependent variables, and items related to oral health behaviors were used as independent variables. In addition, the differences in values of MSS

Table 3　Characteristics of the scale items from the motivation scale (n=221)

Item	Mean	SD	Item-total correlation[#]	Cronbach's Alpha after item removal
Q1. Frequency of scaling	2.5	1.47	0.444**	0.665
Q2. Willingness to undergo treatment	2.5	1.94	0.553**	0.652
Q3. Difficulty of periodontal treatment	2.6	1.95	0.299**	0.698
Q4. Frequency of oral self-care	4.3	0.61	0.076	0.689
Q5. Amount of time spent on oral self-care	3.7	0.73	0.043	0.693
Q6. Tooth cleaning after scaling	3.1	2.00	0.554**	0.652
Q7. Adherence to the recommendations	2.2	1.83	0.617**	0.638
Q8. Feeling need for periodontal treatment	4.6	1.22	0.321**	0.678
Q9. Influence of previous treatment	2.0	1.73	0.564**	0.648
Q10. Initial therapy was pleasant	3.2	1.99	0.559**	0.651
Q11. General health	4.3	1.54	0.510**	0.656
Q12. Cooperation with the periodontal team	4.5	1.35	0.477**	0.660
Q13. Unpleasant incidents during treatment	4.1	1.68	0.421**	0.671
Q14. Distance from the periodontal practice	3.9	1.79	0.433**	0.671

[#]Pearson's correlation coefficient, **: $p<0.01$

between categories of clinical parameters or health behavior were analyzed by the Mann-Whitney *U* test.

Regarding the longitudinal study, McNemar's test was used to investigate changes of oral conditions and oral health behavior. Changes in values of MSS were analyzed by the Wilcoxon signed-rank test. Differences of MSS between categories after basic periodontal therapy were analyzed by the Mann-Whitney *U* test.

SPSS Statistics 28 (IBM Japan, Tokyo) was used for statistical analysis, and the significance level was set at less than 0.05.

6. Ethics

The Ethics Committee of Tokushima University Hospital approved this study (Protocol approval number: 3684-1). An information disclosure document was prepared and posted in the dental clinic, explaining that consent was or was not given at the discretion of the individual in addition to the purpose and contents of the survey.

Results

1. Reliability analysis of the MSS

Cronbach's alpha of the motivation scale was 0.683, indicating that this scale is a generally reliable tool. The correlations between each item and all remaining items were greater than 0.4 for 10 of the 14 items, as shown in Table 3. The correlations with item Q4, "How many times do you brush your teeth according to the recommendations," and item Q5, "How much time do you spend brushing your teeth at a time," were not significant. However, Cronbach's alpha increased only slightly when these items were removed from the scale. Therefore, these items were left in the scale because of the additional information they provided.

2. Principal component analysis of MSS

In order to examine the factor structure of the scale, principal component analysis was performed. Analysis of the scree plot yielded a model (Table 3) consisting of five factors, which together explained 50% of the variance. Among these, two factors had a variance of 10% or more: factor 1 (MSS-F1: oral hygiene practices) for items Q1, Q6, Q7, Q9, and Q10, which accounted for 17.2% of the variance, and factor 2 (MSS-F2: understanding the need for periodontal treatment) for items Q8, Q11, and Q12, which accounted for 13.9%. The data of MSS-F1 and MSSF-2 were used in the analysis in addition to MSS.

3. Association between clinical parameters and oral health behaviors at baseline

Factors affecting clinical parameters at the baseline are shown in Table 2. There were significant differences in the items of "sex," "regular dental check-ups,"

Table 4 Item loadings on factors of motivation: principal component analysis with Varimax rotation

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Q7. Adherence to recommendations	**0.699**	0.038	0.169	−0.012	0.163
Q6. Tooth cleaning after scaling	**0.680**	0.021	−0.176	−0.076	0.200
Q1. Frequency of scaling	**0.642**	−0.051	−0.091	0.432	−0.053
Q10. Initial therapy was pleasant	**0.591**	0.124	0.153	0.054	−0.133
Q9. Influence of previous treatment	**0.585**	0.153	0.167	−0.313	0.008
Q11. General health	0.127	**0.843**	0.085	0.043	0.038
Q12. Cooperation with the periodontal team	0.071	**0.794**	0.224	−0.069	0.006
Q8. Feeling need for periodontal treatment	0.024	**0.692**	−0.067	0.034	−0.013
Q5. Amount of time spent on oral self-care	0.190	0.097	**−0.682**	−0.325	−0.190
Q14. Distance from the periodontal practice	0.187	0.160	**0.632**	−0.099	−0.022
Q13. Unpleasant incidents during treatment	0.237	0.157	**0.570**	−0.361	−0.174
Q4. Frequency of oral self-care	0.036	0.070	−0.007	**0.831**	−0.046
Q3. Difficulty of periodontal treatment	0.058	−0.018	−0.036	−0.091	**0.877**
Q2. Willingness to undergo treatment	0.449	0.136	0.159	0.216	**0.451**
Eigenvalue	2.941	1.746	1.299	1.150	1.037
Variance explained, R^2 (%)	17.20	13.90	9.97	9.23	8.08

and "use of interdental cleaning tools" between participants with BOP lower than 10% and 10% or higher. Similar results were obtained between participants with PISA lower than 130.33 mm^2 and 130.33 mm^2 or higher in addition to the "use of chlorhexidine". There were also significant differences in the items of "regular dental check-ups" and "use of interdental cleaning tools" between patients with PCRs lower than 20% and 20% or higher.

Comparing the baseline characteristics of the 31 dropouts from this study and 221 participants, there were no significant differences in clinical parameters and oral health behaviors regarding the items in Table 2 except for the item 10% BOP or higher (29/31 versus 169/221, respectively, p=0.03). Also, no significant difference of MSS was observed between the two groups.

4. Binomial logistic regression analysis of oral health behaviors related to clinical parameters

Table 5 shows the results of binomial logistic regression analysis with BOP, PISA, and PCR as dependent variables and items related to oral health behaviors as independent variables at the baseline. The item significantly correlated with 10% BOP or higher was "use of interdental cleaning tools": Sometimes (OR=3.260, p<0.01) and Never (OR=2.918, p<0.05), indicating that participants who did not use interdental cleaning tools had a risk of 10% BOP or higher. However, there were no significant differences in the other parameters.

5. Changes of clinical parameters and oral health behaviors after basic periodontal therapy

Table 6 shows the clinical parameters and oral health behaviors after basic periodontal therapy. Desirable improvements were observed in all items except for "current smoking status".

6. Association between MSS and clinical parameters and oral health behaviors

The median MSS values at the baseline and after basic periodontal therapy were 48.0 and 62.0, respectively, showing a significant increase (p<0.01). Table 7 and Figure 2 show the results of the analysis of differences in MSS between the categories of clinical parameters. Regarding BOP at the baseline, the values of MSS and MSS-F1 in participants with BOP lower than 10% were significantly higher in those with 10% BOP or higher. Regarding PCR after basic periodontal therapy, the values of MSS in participants with PCR lower than 20% were significantly higher than in those with 20% PCR or higher.

Figure 3 show the results of the analysis of differences in MSS or MSS-F1 between categories of oral health

Table 5　The factors of oral health behavior related to clinical parameters at the baseline

Item	BOP[a] OR（95% Cl）	*p*-value[#]	PISA[b] OR（95% Cl）	*p*-value[#]	PCR[c] OR（95% Cl）	*p*-value[#]
Sex						
Female	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Male	1.716 (0.746–3.948)	0.204	2.112 (0.799–5.581)	0.131	1.181 (0.291–4.785)	0.816
Age						
20–39	1.00 (ref)		1.00 (ref)		1.00 (ref)	
40–64	1.109 (0.560–2.198)	0.766	1.046 (0.499–2.196)	0.905	0.459 (0.141–1.493)	0.195
Regular dental check-ups						
Yes	1.00 (ref)		1.00 (ref)		1.00 (ref)	
No	1.443 (0.712–2.924)	0.309	1.884 (0.877–4.046)	0.104	2.313 (0.665–8.048))	0.187
Use of interdental cleaning tools						
Every day	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Sometimes	3.260 (1.476–7.664)	0.004 **	1.607 (0.690–3.743)	0.271	3.238 (0.813–12.905)	0.096
Never	2.918 (1.253–7.302)	0.016 *	2.256 (0.825–6.168)	0.113	3.543 (0.627–20.013)	0.152
Current smoking habit						
No	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Yes	1.191 (0.344–4.121)	0.783	0.930 (0.229–3.781)	0.919	0.608 (0.098–3.791)	0.594
Use of chlorhexidine						
Yes	1.00 (ref)		1.00 (ref)		1.00 (ref)	
No	1.718 (0.429–6.878)	0.444	3.745 (0.900–13.418)	0.071	1.513(0.156–14..632)	0.721

[#]Binominal logistic regression analysis, *: $p<0.05$, **: $p<0.01$
Dependent variables: [a]: BOP≥10%=1, <10% =0, [b]: PISA≥130.33 mm^2=1, <130.33 mm^2=0, [c]: PCR≥20%=1, <20%=0
Independent variables: Sex, Age, Regular dental check-ups, Use of interdental cleaning tools, Current smoking status, Use of chlorhexidine

Table 6　Changes of clinical parameters and oral health behaviors after basic periodontal therapy

Item	Category	At the baseline	After basic periodontal therapy	*p*-value[#]
Clinical parameter				
BOP	<10%	52 (23.5)	169 (76.5)	<0.001 **
	≥10%	169 (76.5)	52 (23.5)	
PISA	<130.33 mm^2	41 (18.6)	144 (65.2)	<0.001 **
	≥130.33 mm^2	180 (81.4)	77 (34.8)	
PCR	<20%	15 (6.8)	106 (48.0)	<0.001 **
	≥20%	206 (93.2)	115 (52.0)	
Oral health behavior				
Use of interdental cleaning tools	Every day	66 (29.9)	176 (79.6)	<0.001 **
	Sometimes	78 (35.3)	40 (18.1)	
	Never	77 (34.8)	5 (2.3)	
Frequency of eating between meals	Sometimes or never	66 (29.9)	194 (87.8)	<0.001 **
	Once or more	155 (70.1)	27 (12.2)	
Current smoking status	No	193 (87.3)	195 (88.2)	0.625
	Yes	28 (12.7)	26 (11.8)	
Use of fluoride	Yes	200 (90.5)	212 (95.9)	<0.001 **
	No	21 (9.5)	9 (4.1)	
Use of chlorhexidine	Yes	10 (4.5)	101 (45.7)	<0.001 **
	No	211 (95.5)	120 (54.3)	
Use of xylitol	Yes	9 (4.1)	72 (32.6)	<0.001 **
	No	212 (95.9)	149 (67.4)	

[#]McNemar test or Wilcoxon signed-rank test, **: $p<0.01$

Table 7 Relationship between MSS, MSS-F1, MSS-F2, and clinical parameters or oral health behaviors at the baseline and after basic periodontal therapy

Items	Category	At the baseline						After basic periodontal therapy					
		MSS			MSS-F1		MSS-F2	MSS			MSS-F1		MSS-F2	
		n	median (1st -3rd quartile)	p-value†	median (1st -3rd quartile)	p-value†	median (1st -3rd quartile)	p-value†	n	median (1st -3rd quartile)	p-value†	median (1st -3rd quartile)	p-value†	median (1st -3rd quartile)	p-value†
All		221	48.0 (40.5–55.0)	–	9.0 (5.0–14.0)	–	15.0 (15.0–15.0)	–	221	62.0 (59.0–65.5)#	–	25.0 (21.0–25.0)#	–	15.0 (15.0–15.0)	–
Sex	Male	73	47.0 (39.0–53.0)	0.335	8.0 (4.50–12.50)	0.074	15.0 (15.0–15.0)	0.650	73	62.0 (58.0–65.0)	0.150	23.0 (21.0–25.0)	0.124	15.0 (15.0–15.0)	0.277
	Female	148	48.0 (41.0–56.0)		9.0 (5.25–14.0)		15.0 (12.0–15.0)		148	62.5 (60.0–66.0)		25.0 (21.0–25.0)		15.0 (15.0–15.0)	
Clinical parameter															
BOP	<10%	52	49.0 (42.25–59.0)	0.046*	10.0 (6.0–16.0)	0.014*	15.0 (15.0–15.0)	0.595	169	63.0 (59.0–66.0)	0.232	23.0 (21.0–25.0)	0.868	15.0 (15.0–15.0)	0.236
	≥10%	169	47.0 (40.0–53.5)		8.0 (5.0–13.0)		15.0 (11.0–15.0)		52	61.0 (59.25–65.0)		25.0 (21.0–25.0)		15.0 (15.0–15.0)	
PCR	<20%	15	48.0 (44.0–54.0)	0.898	10.0 (6.0–16.0)	0.497	15.0 (11.0–15.0)	0.993	106	64.0 (60.0–66.0)	0.044*	25.0 (21.0–25.0)	0.346	15.0 (15.0–15.0)	0.051
	≥20%	206	47.5 (40.0–55.0)		8.0 (5.0–14.0)		15.0 (15.0–15.0)		115	62.0 (58.0–65.0)		23.0 (21.0–25.0)		15.0 (15.0–15.0)	
PISA	<130.33 mm^2	41	47.0 (41.0–57.0)	0.797	9.0 (6.0–16.0)	0.276	15.0 (11.0–15.0)	0.149	144	62.5 (59.0–66.0)	0.601	23.0 (21.0–25.0)	0.103	15.0 (15.0–15.0)	0.192
	≥130.33 mm^2	180	48.0 (40.0–55.0)		8.50 (5.0–13.0)		15.0 (15.0–15.0)		77	62.0 (60.0–65.0)		25.0 (21.0–25.0)		15.0 (15.0–15.0)	
Oral health behavior															
Use of interdental cleaning tools	Every day	66	52.0 (43.5–60.0)	<0.001**	12.0 (8.0–16.0)	<0.001**	15.0 (15.0–15.0)	0.602	176	63.0 (60.0–66.0)	0.315	25.0 (21.0–25.0)	0.003**	15.0 (15.0–15.0)	0.769
	Sometimes	78	47.0 (41.75–53.0)		9.0 (5.75–14.0)		15.0 (11.0–15.0)		40	62.0 (56.0–65.0)		23.0 (21.0–25.0)		15.0 (15.0–15.0)	
	Never	77	44.0 (36.5–51.5)		8.0 (4.0–10.0)		15.0 (15.0–15.0)		5	58.0 (46.0–66.0)		21.0 (11.0–23.0)		15.0 (13.0–15.0)	
Regular dental check-ups	Yes	82	52.0 (45.0–59.0)	<0.001**	12.0 (8.0–16.0)	<0.001**	15.0 (15.0–15.0)	0.757	221	62.0 (59.0–65.5)	–	25.0 (21.0–25.0)	–	15.0 (15.0–15.0)	–
	No	139	44.0 (39.0–52.0)		8.0 (4.0–12.0)		15.0 (11.0–15.0)		0	–		–		–	
Frequency of eating between meals	Sometimes or never	66	48.0 (40.0–53.5)	0.726	8.0 (5.0–13.25)	0.450	15.0 (14.0–15.0)	0.965	194	62.0 (60.0–66.0)	0.602	25.0 (21.0–25.0)	0.136	15.0 (15.0–15.0)	0.368
	Once or more	155	47.0 (41.0–56.0)		9.0 (5.0–14.0)		15.0 (15.0–15.0)		27	62.0 (58.0–65.0)		23.0 (21.0–25.0)		15.0 (15.0–15.0)	
Current smoking habit	No	193	48.0 (41.0–55.50)	0.175	9.0 (5.0–14.0)	0.005**	15.0 (15.0–15.0)	0.931	195	62.0 (60.0–65.0)	0.758	25.0 (21.0–25.0)	0.022*	15.0 (15.0–15.0)	0.708
	Yes	28	47.0 (36.0–52.75)		7.0 (4.0–8.75)		15.0 (12.0–15.0)		26	63.5 (56.0–66.25)		23.0 (17.75–25.0)		15.0 (15.0–15.0)	
Use of fluoride	Yes	200	47.0 (40.0–55.0)	0.174	9.0 (5.0–14.0)	0.787	15.0 (11.0–15.0)	0.265	212	62.0 (59.0–65.75)	0.852	25.0 (21.0–25.0)	0.970	15.0 (15.0–15.0)	0.310
	No	21	51.0 (43.5–55.5)		8.0 (4.5–13.0)		15.0 (15.0–15.0)		9	63.0 (60.0–66.0)		23.0 (21.0–25.0)		15.0 (15.0–15.0)	
Use of chlorhexidine	Yes	10	45.0 (41.0–58.75)	0.98	9.0 (5.0–17.0)	0.607	15.0 (15.0–15.0)	0.069	101	63.0 (59.5–65.5)	0.775	23.0 (21.0–25.0)	0.285	15.0 (15.0–15.0)	0.315
	No	211	48.0 (40.0–55.0)		9.0 (5.0–13.0)		15.0 (11.0–15.0)		120	62.0 (59.0–65.75)		25.0 (21.0–25.0)		15.0 (15.0–15.0)	
Use of xylitol	Yes	9	57.0 (46.5–62.5)	0.052	14.0 (8.5–16.5)	0.093	15.0 (15.0–15.0)	0.379	72	62.0 (59.0–66.0)	0.595	25.0 (21.0–25.0)	0.655	15.0 (15.0–15.0)	0.602
	No	212	47.0 (40.0–55.0)		8.0 (5.0–13.0)		15.0 (12.0–15.0)		149	62.0 (59.5–65.0)		23.0 (21.0–25.0)		15.0 (15.0–15.0)	

†: Mann-Whitney U tests or Kruskal-Wallis tests of MSS, MSS-F1 and MSS-F2, *: $p<0.05$, **: $p<0.01$

#: Wilcoxon signed-rank sum test comparing baseline for all subject, $p<0.01$

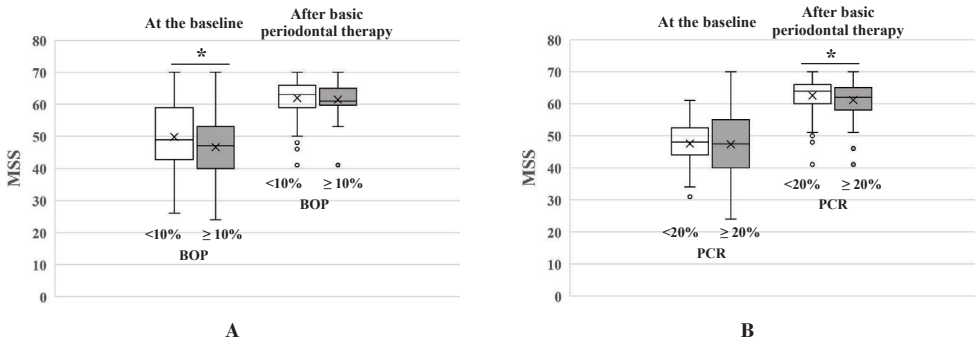

Figure 2　Association between MSS and clinical parameters at the baseline and after basic periodontal therapy. Mann-Whitney *U* tests, *: $p<0.05$

A: BOP and MSS, B: PCR and MSS

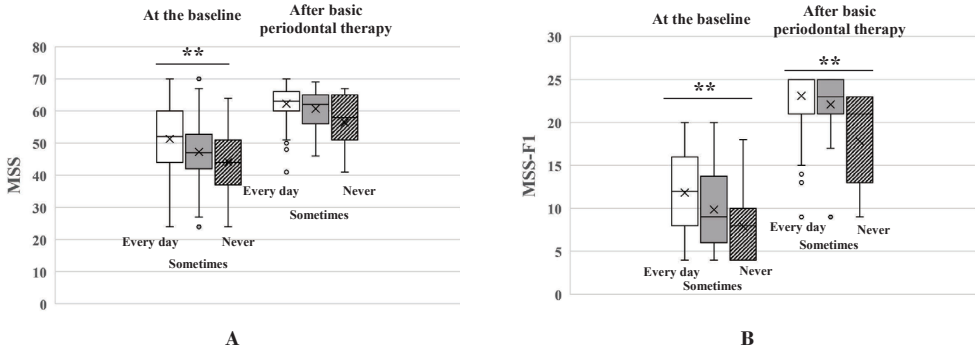

Figure 3　Association between MSS, MSS-F1 and oral health behavior at the baseline, and after basic periodontal therapy. Kruskal-Wallis tests, **: $p<0.01$

A: Use of interdental cleaning tools and MSS, B: Use of interdental cleaning tools and MSS-F1

behaviors in addition to Table 7. The values of MSS and MSS-F1 in patients were significantly higher in participants who received regular dental check-ups and used interdental cleaning tools at the baseline. These results were considered to be part of the validity of MSS. The value of MSS-F1 in participants who used interdental cleaning tools was also significantly higher even after basic periodontal therapy. Furthermore, the value of MSS-F1 was significantly higher in non-smokers both at the baseline and after basic periodontal therapy.

Discussion

The success of periodontal treatment is considered to be influenced by a patient's daily oral self-care[20]. The patient needs to maintain a high level of motivation for self-care. In this study, motivation related to the oral condition was evaluated on receiving basic periodontal therapy. The main finding of this study was that MSS was related to the periodontal condition of BOP and oral health behavior, such as the use of interdental cleaning tools at the baseline, whereas no relation was observed after basic periodontal therapy. These results suggest that high motivation may lead to a good periodontal condition, and enhancing motivation may lead to good oral health behavior in patients with periodontal disease.

The motivation assessment scale using a self-reported questionnaire was evaluated for reliability, as shown in Table 3. Cronbach's alpha of the motivation scale in this study was slightly lower compared with the data from the report by Pac et al.[12]. The reason is unclear, but the results might be due to differences in the average age of the subjects (this study: 38.2 years versus the study by Pac et al.[12]: 51.4 years) or the changes in Items 4 and 5, which were modified to reflect the current situation in Japan.

On the other hand, factor analysis indicated that MSS-F1 (oral hygiene practice) and MSS-F2 (understanding of the need for periodontal treatment) were factors that influenced motivation, which complemented the main aspects of the motivational process. It revealed that the items of regular dental check-ups and use of interdental cleaning tools were related to the values of MSS and MSS-F1. The association between MSS and the periodontal condition was also revealed as well as the report of Oruba et al.[13]. It is considered that there was content validity in the motivation scale. The reliability and validity of MSS were generally adequate in this study, indicating that it may be useful for patients with periodontal disease.

As shown in Table 7, the values of MSS and MSS-F1 significantly increased from the baseline to after basic periodontal therapy, suggesting that the contents of basic periodontal therapy influenced the motivation of participants. It was reported that regular interdental cleaning was associated with better oral hygiene outcomes, such as dental plaque and gingivitis[21]. As shown in Table 5, the "use of interdental cleaning tools" was an important factor significantly correlated in participants with PCR lower than 20%, BOP lower than 10%, and PISA lower than 130.33 mm^2 in the baseline analysis, and its involvement was confirmed in binomial logistic regression analysis for BOP lower than 10%. Furthermore, the higher values of MSS and MSS-F1 at the baseline were observed in participants who used interdental cleaning tools. Therefore, it is important to promote the use of interdental cleaning tools during basic periodontal therapy.

It has been reported that patients showing high-level compliance with periodontal treatment are less likely to lose teeth during periodontal treatment than those with low compliance[22, 23]. This indicates that high compliance with periodontal treatment and appropriate oral hygiene practice are necessary for periodontal treatment, and motivation is required to maintain these circumstances. In this study, the higher value of MSS-F1, which is a factor related to oral hygiene practices, was observed in participants who used interdental cleaning tools after basic periodontal therapy. In addition, MSS was significantly lower in patients with PCR higher than 20% after basic periodontal treatment. Therefore, an individual approach is required. It is considered that changes in motivation may lead to the use of interdental cleaning tools by influencing compliance with oral health behaviors. It may contribute to conscious efforts toward plaque control to improve oral hygiene, and a decrease in PCR as a result.

It has been reported that few patients comply with the suggestions of specialists because periodontal disease is a chronic disease and patients often do not recognize it as a threat[24]. However, the values of both MSS-F1 (Practice of oral hygiene) and MSS-F2 (Understanding of the need for periodontal treatment) significantly increased after basic periodontal treatment in this study. It is considered that OHI provided in this study led patients to comply with the suggestions of dental professionals and increased their motivation to maintain good oral health.

On the other hand, no significant improvement was observed in the item of the current smoking status in participants after basic periodontal therapy, as shown in Table 7 although behavioral change by intervention was desirable. The value of MSS-F1 was significantly lower in smokers than in nonsmokers at the baseline. When applied to the behavioral change stage model[25], if the patient can move from the stage of no interest in smoking cessation to the action stage of smoking cessation by OHI during basic periodontal therapy, oral hygiene practice is expected to improve as a synergistic effect through an increase in the value of MSS-F1.

There is an association between patient characteristics and the contents of guidance in achieving behavioral goals[26]. Dental health guidance requires appropriate instruction for oral conditions, based on an understanding of the characteristics and lifestyle of patients. For oral health in patients throughout their lives, it is necessary to maintain motivation for appropriate oral health management, including periodontal treatment.

The first limitation of this study was that we were not able to design a control group that did not receive basic periodontal treatment. The second limitation was that there were differences regarding the contents during basic periodontal therapy. Whereas there was concern about variations due to intervenors, no differences in MSS were observed due to differences in the number of interventions or dental hygienists in charge. In addi-

tion, this study did not determine criterion validity of MSS. Future studies using MSS should consider these points when planning study designs.

Conclusions

MSS used in this study was useful and associated with the periodontal condition and oral health behavior at the baseline. The values of MSS and MSS-F1 significantly increased after basic periodontal therapy. The use of interdental cleaning tools was associated with a good oral condition, and it was also associated with higher MSS. These results suggest that high motivation might lead to a good oral condition in patients with periodontal disease through the use of interdental cleaning tools by influencing patient compliance for improving their oral health behaviors.

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Reprint requests to D. HINODE, Department of Hygiene and Oral Health Science, Tokushima University Graduate School of Biomedical Sciences, 18-15 Kuramotocho 3-chome, Tokushima 770-8504, Japan
TEL: 088-633-7543
E-mail: hinode@tokushima-u.ac.jp

歯周基本治療におけるモチベーションスケールスコアと口腔状態の関連性

佐久間　愛[1,2)]　福井　誠[1)]　麻生　幸男[2)]　日野出大輔[1)]

[1)]徳島大学大学院医歯薬学研究部口腔保健衛生学分野
[2)]麻生歯科クリニック

概要：本研究の目的は，日本の成人に対するモチベーションスケールスコア（MSS）の有用性を評価すること，および歯周基本治療における口腔状態に関連するモチベーションを，MSS を用いて検討することである．

対象者は静岡市の歯科診療所に来院した 20～64 歳の初診歯周病患者 221 名である．MSS は患者のモチベーション評価尺度に関する 14 項目の質問紙を用いて算出し，MSS の主成分分析を行った．また，ベースライン時および歯周基本治療後の MSS と口腔保健行動項目，歯周状態［Bleeding on probing（BOP）率，Periodontal inflamed surface area（PISA）］および口腔衛生状態［O'Leary の Plaque control record（PCR）］との関係を評価した．

MSS は信頼性と妥当性の点からその有用性が示され，5 つの要素に分類された．ベースライン時 BOP10% 未満の者は BOP10% 以上の者と比較して MSS および MSS-F1（口腔衛生行動）が有意に高かった．また，年 1 回の歯科健診受診，歯間部清掃用具の使用の者は MSS および MSS-F1 が有意に高く，非喫煙者で MSS-F1 が有意に高かった．二項ロジスティック回帰分析において，ベースライン時 BOP10% 以上と統計学的に有意な関連を認めた因子は歯間部清掃用具の使用であった．一方，歯周基本治療後，喫煙状況を除くすべての項目で良好な改善が認められた．このうち，歯周基本治療後の PCR20% 未満の者は MSS が有意に高く，歯間部清掃用具の使用および非喫煙者において MSS-F1 が有意に高かった．

本研究で用いた MSS は有用であり，ベースライン時の歯周組織状態および口腔保健行動と関連した．歯周基本治療介入後，MSS および MSS-F1 の値は有意に上昇した．歯間部清掃用具の使用は良好な歯周組織状態と関連し，MSS の高値と関連した．それ故，高いモチベーションが，歯間部清掃用具の使用によって口腔保健行動の改善に対する患者のコンプライアンスに影響を与え，歯周病患者の良好な口腔状態を導いた可能性がある．

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索引用語：モチベーションスケールスコア，歯周基本治療，口腔保健行動，歯間部清掃用具

著者への連絡先：日野出大輔　〒770-8504　徳島市蔵本町3-18-15　徳島大学大学院医歯薬学研究部口腔保健衛生学分野
TEL : 088-633-7543
E-mail : hinode@tokushima-u.ac.jp