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Association between self-efficacy and loss to follow-up in long-term periodontal treatment

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Abstract

Aim: To examine whether or not oral health care-specific self-efficacy can predict loss to follow-up for long-term periodontal treatment.

Methods: Our prospective cohort study enrolled 144 patients with chronic periodontitis. Patient self-efficacy was assessed on the initial visit using the self-efficacy scale for self-care (SESS). Participants were then followed for 30 months from the onset of periodontal treatment. The loss to follow-up is the main outcome variable. Multiple logistic regression analysis was conducted to examine the association between self-efficacy for self-care and loss to follow-up for periodontal treatment. Gender, age, number of teeth, probing depth, plaque control record (PCR) value, PCR improvement rate, general self-efficacy scale score, and SESS score were used as the independent variables, and loss to follow-up as a dependent variable.

Results: A total of 67 patients were lost to follow-up over the course of the study. Compared with the high-scoring SESS group (60–75), the odds ratio of loss to follow-up for the middle- (54–59) and low-scoring groups (15–53) were 1.05 [95% confidence interval (CI): 0.36–3.07] and 4.56 (95% CI: 1.11–18.74), respectively.

Conclusion: Assessment of oral health care-specific self-efficacy may be useful in predicting loss to follow-up in long-term periodontal treatment.

In 1977, Bandura advocated the concept of self-efficacy within the framework of social learning theory, asserting that the confidence of an individual determines ''how well he/she can take the actions necessary for producing certain results''. In clinical practice, self-efficacy refers to ''how certain a patient feels about his/her ability to take the actions necessary for improvement of symptoms and maintenance of health'' (Kakudate et al. 2008). In medical clinical practice, several studies have found that symptoms of diabetes and other chronic diseases can be improved by enhancing self-efficacy, and attention has been focused on the function of self-efficacy as an antecedent factor in behaviour modification (Grossman et al. 1987, Smarr et al. 1997). However, oral health care-specific self-efficacy has been largely uninvestigated.

Previous reports have cited the effectiveness of periodontal patient self-care and regular visits to a dental professional for maintenance (Kressin et al. 2003, Axelsson et al. 2004, Douglass 2006). Whether or not patients with periodontal disease can properly adhere to these health regimens is the key to success in treating periodontal diseases. Therefore, those patients with relatively greater self-efficacy may exhibit overall better self-care behaviour and adhere more successfully to dental treatment than those with relatively lower self-efficacy. In fact, several studies have reported an association between self-efficacy and self-care behaviours such as brushing or flossing frequency (McCaul et al. 1985, Tedesco et al. 1991, 1992, Stewart et al. 1997, Syrjälä et al. 2004). For example, McCaul et al. (1985) analysed self-efficacy concerning brushing and flossing to predict these behaviours among 131 college students, ultimately finding that self-

efficacy was significantly related to both retrospectively reported and prospectively self-monitored frequency of brushing and flossing. However, few studies have attempted to examine the association between self-efficacy of periodontal patients and their adherence to long-term periodontal treatment regimens, including maintenance care by professionals.

Two levels of self-efficacy have been established (Sherer et al. 1982, Woodruff & Cashman 1993, Stanley & Murphy 1997). One is general self-efficacy, which is self-efficacy as the general tendency of an individual, and the other is task-specific self-efficacy, which is related to a certain task. We recently developed a task-specific self-efficacy scale for self-care (SESS) for use with periodontal disease patients (Kakudate et al. 2007, 2008) consisting of three subscales: self-efficacy for dentist consultations (SE-DC), self-efficacy for brushing the teeth (SE-B), and self-efficacy for dietary habits (SE-DH). In our pilot study, we examined whether or not the SESS and general self-efficacy scale (GSES) (Sakano & Tohjoh 1986) are useful in predicting short-term (within 1 year) compliance with active periodontal treatment (Kakudate et al. 2008). Results showed that the SESS and SE-DC subscale were able to predict loss to follow-up from active periodontal treatment, while the GSES was not (Kakudate et al. 2008). As it is also important to maintain periodontal health even after active periodontal treatment, we further focused on the hypothesis that SESS can predict patient loss to follow-up in the long-term period of periodontal treatment. If this hypothesis is true, it follows that the SESS can provide us with extremely useful information rega;rding whether or not patients can be followed-up for long-term periodontal treatment. Furthermore, it is possible that psycho-educational intervention to enhance self-efficacy may reduce loss to follow-up problem. Here, we examined the feasibility of using the SESS to predict loss to follow-up from long-term periodontal treatment in patients with mild to moderate chronic periodontitis in a 30-month long longitudinal prospective cohort study.

Methods

We conducted our prospective cohort study from April 2006 to July 2009.

Ethical approval was obtained from the Hokkaido University Graduate School of Dental Medicine Ethics Committee.

Participants

A total of 144 participants aged 19–86 years (mean age: 51.8 ± 15.6 years, female:male = 65:79) were consecutively sampled Japanese patients who visited a private dental clinic in Sapporo, Japan, for periodontal treatment. Patients were diagnosed with mild to moderate chronic periodontitis according to the criteria of Hirschfeld & Wasserman (1978) and the former criteria of the American Dental Association (ADA) (Lanning et al. 2006), and then classified according to probing depth and radiographic bone loss. Hirschfeld's & Wasserman (1978) criteria were used when assessing probing depth, with diagnosis conducted as follows: ''early (periodontitis)'', for pockets of $\leqslant 4\,mm$, generally with gingival inflammation and subgingival calculus deposits; ''intermediate'', for pockets of 4–$7\,mm$ present around a number of teeth; and ''advanced'', for pockets $> 7\,mm$ deep, with furcation involvement of at least one tooth. Diagnosis using the former criteria of the ADA was conducted as follows: ''slight (periodontitis)'', for $< 15\%$ bone loss; ''moderate'', for 15–30% bone loss, and ''severe'', for $> 30\%$ bone loss. All participants in the present study were found to have ''early'' or ''intermediate'' periodontitis as defined by Hirschfeld & Wasserman (1978) and ''slight'' or ''moderate'' periodontitis as defined by the former criteria of the ADA (Lanning et al. 2006). These criteria were used for the diagnosis of mild to moderate periodontitis in this study because attachment loss was not sufficiently recorded at the setting of this study.

Active periodontal treatment was administered to patients during the first year following their initial visit. Treatment included oral hygiene enhancement, scaling and root planing, and surgical therapy. Restorative endodontic therapy was also provided to patients according to individual needs (Miyamoto et al. 2006). Patients who completed active treatment entered maintenance therapy following their first year of treatment. Before moving into maintenance care, the participant's periodontal status had to meet the following criteria (Miyamoto et al. 2006): bleeding on

probing observed in $< 10\%$ of sites, overall plaque score $< 15\%$ (O'Leary et al. 1972), and probing depth $\geqslant 4\,mm$ for $< 10\%$ of sites. Maintenance schedules were conducted at 2–6-month intervals, based on individual plaque control, severity of disease and residual pockets, and furcation involvement. All patients gave informed consent to take part in this prospective cohort study.

Exclusion criteria

Potential participants were excluded if they had physical limitations interfering with manual dexterity, fewer than 18 teeth, diabetes mellitus or immunodeficiency, or if they were taking medications known to affect inflammation of gingival tissues, such as phenytoin, antisialogogue medication, steroids, or other hormone medications, and if they required prophylactic antibiotic premedication (Little et al. 1997, Kakudate et al. 2008). Patients who had undergone extensive non-surgical periodontal treatment within the previous 6 months, periodontal surgery within the previous 2 years, or who were undergoing any active periodontal treatment were also excluded.

Main outcome measure

The main outcome measure of the present study was risk of loss to follow-up from long-term periodontal treatment and its association with SESS. We defined a patient as lost to follow-up if the patient did not present him- or herself at an appointment and did not express the desire to receive consultation within 1 month from the day of the appointment.

Assessment of self-efficacy

SESS (Kakudate et al. 2007, 2008) and GSES (Sakano & Tohjoh 1986) scores were obtained before active periodontal treatment. Each patient was asked to complete questionnaires for the SESS (Kakudate et al. 2007, 2008) and GSES (Sakano & Tohjoh 1986), with one principal investigator (N. K.) supervising the patients to ensure that all questions were correctly understood and fully answered.

The SESS has been described previously (Kakudate et al. 2007, 2008). Briefly, the scale consists of 15 items divided into three subscales: SE-DC which is evaluating self-efficacy for

continuing treatment and regular dental check-ups (SE-DC, five items; for example, ''I go to the dentist for treatment of periodontal disease''), self-efficacy for brushing of the teeth which is evaluating self-efficacy for brushing their own teeth carefully and thoroughly (SE-B, five items; for example, ''I brush my teeth as instructed''), and self-efficacy for dietary habits which is evaluating self-efficacy for taking a well-balanced eating and drinking habit (SE-DH, five items; for example, ''I eat my meals at fixed times during the day''). Individual responses were graded on a five-point Likert scale from 1 (not confident) to 5 (completely confident). The SESS has the instruction as follows: ''Please read the following questions. After each question, please make a check in the circle to show how much you believe you can or cannot do what is asked now''. This instruction form was made referring to the style of Grossman et al. (1987). The SESS score for each subject was expressed as the sum of the scores assigned for the 15 items, with the total score therefore having a range between 15 and 75. Participants were subsequently classified into one of three categories according to tertile cutoff points for SESS score.

The SESS has been verified to have high reliability and validity through conventional assessment methods (Edward & Richard 1980, Syrjälä et al. 1999, Resnick et al. 2000, Travess et al. 2004, Champion et al. 2005, George et al. 2007, Rossen & Gruber 2007). Further, reliability has been demonstrated for both internal consistency and test-retest stability (Kakudate et al. 2007). Construct validity was also shown in a recent cross-sectional study, in which patients in the maintenance phase of periodontal treatment were found to have a significantly higher SESS score than patients visiting the office for the first time (Kakudate et al. 2007).

The GSES (Sakano & Tohjoh 1986) is comprised of 16 items divided into three subscales: activity in behaviour which is evaluating the self-efficacy for positive approach on work (seven items; for example, ''I tend to carry out my work with confidence''), anxiety regarding failure which is evaluating the self-efficacy for overcoming uneasiness (five items; for example, ''I often feel depressed when I recall past mistakes and bad experiences''), and social

locus of ability which is evaluating the self-efficacy to act with confidence for his/her ability (four items; for example, ''I have better abilities than my friends''). The GSES is widely used in Japan and has been found to be both reliable and valid (Sakano & Tohjoh 1986). Responses to this questionnaire were expressed as ''yes'' or ''no''. A score of 1 was given for answers indicating higher self-efficacy, and 0 for those indicating lower self-efficacy. Possible GSES scores therefore ranged from 0 to 16.

Clinical measurements

Measurements of clinical parameters (probing depth, plaque index, and number of teeth present) were obtained at baseline. Patients were then examined for plaque accumulation on all teeth, which was evaluated by examining the four sides (buccal, lingual, mesial, and distal) of each tooth using the plaque control record (PCR) developed by O'Leary et al. (1972). Tooth-brushing instructions provided to participants were based on the Bass method (Bass 1948) and covered brushing pressure, how to move the toothbrush, and how to use dental floss and an inter-dental brush. Plaque accumulation was reevaluated approximately 1 week later. PCR measurements were conducted after sufficient calibration by one dentist (M. M.). Calibration of probing depth was performed by another dentist (N. K.) before the study, and intra-examiner error for this parameter was determined to be extremely low. Examinations were performed twice with a 1-week interval. Agreement was observed at $r > 0.8$ (Spearman's rank correlation coefficient) for sites examined in 30 individuals (Kakudate et al. 2008).

Statistical analyses

Rate of improvement in PCR was determined by subtracting the PCR value assessed after tooth brushing instructions were given from the value at the initial visit, and then dividing this value by the initial visit PCR and multiplying by 100 to express the value as a percentage.

Firstly, the correlation between SESS and GSES was examined using Pearson's correlation coefficient. Secondly, unadjusted risk ratio and 95% confidence intervals (CIs) were estimated. Finally, multiple logistic regression ana-

lysis was conducted to examine the relationship between self-efficacy for self-care and loss to follow-up for periodontal treatment. Gender, age, number of teeth, probing depth, PCR value, PCR improvement rate, GSES score and SESS score were used as the independent variables, and loss to follow-up for periodontal treatment was used as a dependent variable. The odds ratios were calculated together with the 95% CIs.

All analyses were performed using SPSS statistical software (version 14.0; SPSS, Inc., Chicago, IL, USA).

Results

Mean SESS and GSES scores and standard deviations (SDs) at baseline were 56.7 ± 10.0 and 8.6 ± 4.0, respectively. Cronbach's α coefficients for SESS and GSES were 0.82 and 0.84, respectively.

Of the 144 participants, 67 were lost to follow-up for periodontal treatment, with 77 continuing treatment. The mean average follow-up periods for the 67 participants who were lost to follow-up were 435.7 ± 299.5 days.

Clinical and demographic characteristics of participants

Tertile cutoff points for the low-, middle-, and high-scoring SESS groups were 15–53, 54–59, and 60–75, respectively. Table 1 shows clinical and demographic characteristics of these groups. The numbers of loss to follow-up for the low-, middle-, and high-scoring SESS groups were 30, 24, and 13, respectively.

Pearson's correlation coefficient among self-efficacy scales

Pearson's correlation coefficient (*r*) among self-efficacy scales are shown in Table 2. SESS score was found to be significantly correlated with SE-DC ($r = 0.71$), SE-B ($r = 0.72$), SE-DH ($r = 0.86$), and GSES scores ($r = 0.46$).

Association between loss to follow-up and clinical and demographic factors

Table 3 describes risk ratios with 95% CIs. Compared with the high-scoring SESS group (60–75), the risk ratio of loss to follow-up for the middle-scoring group (54–59) was 1.88 (95% CI: 1.09–3.27), while that for the low-scoring group (15–53) was 2.74 (95% CI:

Table 1. Clinical and demographic characteristics of participants at baseline

	Self-efficacy scale for self-care (SESS) score		
	15–53 (low) N (%) 43 (100)	54–59 (middle) N (%) 50 (100)	60–75 (high) N (%) 51 (100)
Gender			
Male	28 (65)	24 (48)	27 (53)
Female	15 (35)	26 (52)	24 (47)
Age (years)			
⩽54	40 (93)	31 (62)	7 (14)
⩾55	3 (7)	19 (38)	44 (86)
Mean ± standard deviation	39.1 ± 13.3	52.6 ± 15.4	61.8 ± 8.5
Number of teeth at baseline			
18–23	7 (16)	18 (36)	14 (27)
24–26	20 (47)	16 (32)	21 (41)
27–32	16 (37)	16 (32)	16 (31)
Mean ± standard deviation	25.1 ± 4.0	24.1 ± 4.2	25.0 ± 2.8
Probing depth at baseline (mm)			
⩽2.6	17 (40)	17 (34)	13 (25)
2.6–3.1	16 (37)	14 (28)	18 (35)
>3.1	10 (23)	19 (38)	20 (39)
Mean ± standard deviation	2.8 ± 0.4	3.2 ± 1.1	2.9 ± 0.6
PCR value at baseline			
⩽39	13 (30)	14 (28)	20 (39)
39–62	18 (42)	20 (40)	14 (27)
>62	12 (28)	16 (32)	17 (33)
Mean ± standard deviation	53.5 ± 22.5	49.3 ± 24.6	50.5 ± 28.1
PCR improvement rate			
⩽16%	25 (58)	16 (32)	8 (16)
16–60%	13 (30)	15 (30)	22 (43)
>60%	5 (12)	19 (38)	21 (41)
Mean ± standard deviation	16.2 ± 43.9	37.6 ± 30.1	42.1 ± 54.2
GSES score			
0–6	31 (72)	8 (16)	11 (22)
7–11	8 (19)	20 (40)	16 (31)
12–16	4 (9)	22 (44)	24 (47)
Mean ± standard deviation	5.9 ± 3.4	9.7 ± 3.1	10.1 ± 3.8
Number of loss to follow-up for periodontal treatment	30 (70)	24 (48)	13 (25)

SESS, self-efficacy scale for self-care; PCR, plaque control record; GSES, general self-efficacy scale.

Table 2. Pearson's correlation coefficients between self-efficacy scales ($N = 144$)

	GSES score	SE-DC score	SE-B score	SE-DH score
SESS score	0.46[†]	0.71[†]	0.72[†]	0.86[†]
GSES score	–	0.42[†]	0.32[†]	0.32[†]
SE-DC score	–	–	0.20*	0.40[†]
SE-B score	–	–	–	0.51[†]

*$p < 0.05$,
[†]$p < 0.001$.
SESS, self-efficacy scale for self-care; GSES, general self-efficacy scale; SE-DC, self-efficacy for dentist consultations; SE-B, self-efficacy for brushing of the teeth; SE-DH, self-efficacy for dietary habits.

1.65–4.55). A significant association was noted between SESS score and loss to follow-up in the crude analysis.

Multiple logistic regression analysis of loss to follow-up in long-term periodontal treatment

Table 4 shows the results of multiple logistic regression analyses. Compared with the group with the high-scoring SESS group (60–75), the adjusted odds ratio of loss to follow-up for the middle-scoring SESS group (54–59) was 1.05, while that for the low-scoring SESS group (15–53) was 4.56.

The adjusted odds ratio and 95% CI was additionally calculated for each separate subscale. Compared with the group with SE-DC scores of 22–25, the

adjusted odds ratio of loss to follow-up for the group with scores of 19–21 was 2.42 (95% CI: 0.80–7.26), while that for the group with scores of 5–18 was 4.28 (95% CI: 1.18–15.53). Compared with the group with SE-B scores of 21–25, the adjusted odds ratio of loss to follow-up for the group with scores of 18–20 was 1.14 (95% CI: 0.36–3.57), while that for the group with scores of 5–17 was 0.66 (95% CI: 0.21–2.12). Compared with the group with SE-DH scores of 21–25, the adjusted odds ratio of loss to follow-up for the group with scores of 18–20 was 0.95 (95% CI: 0.33–2.69), while that for the group with scores of 5–17 was 3.95 (95% CI: 1.20–12.97).

Discussion

Here, we examined the feasibility of using task-specific self-efficacy to predict loss to follow-up for periodontal treatment, including maintenance care after active periodontal treatment. Results showed that patients with lower SESS scores were more likely to become lost to follow-up for long-term periodontal treatment. Our findings suggested that SESS score was indeed useful for predicting loss to follow-up for long-term periodontal treatment. We previously reported on the usefulness of SESS in predicting loss to follow-up for short-term active periodontal treatment (Kakudate et al. 2008). Taking into account findings from our previous and present studies, we have determined that SESS can be used to predict patient loss to follow-up for all phases of periodontal treatment.

In our previous study regarding loss to follow-up for active periodontal treatment, SE-DH score did not differ significantly between the continuation group and groups lost to follow-up, thereby indicating that SE-DH could not be used to effectively predict loss to follow-up for active periodontal treatment (Kakudate et al. 2008). However, in the present study, which focused on for long-term periodontal treatment, a higher SE-DH score was found to be significantly associated with loss to follow-up. This finding suggests that patients with no confidence in their ability to control their dietary habits tend to be lost to follow-up for long-term periodontal treatment, but not for complete short-term active periodontal treatment. These observations may be due to differing characteristics between

Table 3. Association between loss to follow-up and clinical and demographic factors

Explanatory variables	Number of participants	Number of loss to follow-up	Risk for loss to follow-up	Risk ratio* (95% CI)	*p*-value
Gender					
Male	79	36	0.46	1	–
Female	65	31	0.48	1.05 (0.74–1.49)	0.80
Age					
≥55 years	66	18	0.27	1	–
≤54 years	78	49	0.63	2.30 (1.50–3.54)	*p* < 0.001
No. of teeth at baseline					
18–23	39	19	0.49	1	–
24–26	57	20	0.35	0.72 (0.45–1.16)	0.18
27–32	48	28	0.58	1.20 (0.80–1.79)	0.37
Probing depth (mm) at baseline (mm)					
≤2.6	47	23	0.49	1	–
2.6–3.1	48	20	0.42	0.85 (0.55–1.33)	0.48
≥3.1	49	24	0.49	1.00 (0.67–1.51)	1.00
PCR value at baseline					
≤39	47	17	0.36	1	–
39–62	52	30	0.58	1.60 (1.02–2.49)	0.032
≥62	45	20	0.44	1.23 (0.75–2.03)	0.42
PCR improvement rate (%)					
≤16%	49	28	0.57	1.22 (0.83–1.82)	0.31
16–60%	50	18	0.36	0.77 (0.48–1.25)	0.29
≥60%	45	21	0.47	1	–
General self-efficacy scale (GSES) score					
0–6	50	26	0.52	1.18 (0.78–1.78)	0.42
7–11	44	19	0.43	0.98 (0.62–1.56)	0.93
12–16	50	22	0.44	1	–
Self-efficacy scale for self-care (SESS) score					
15–53 (low)	43	30	0.70	2.74 (1.65–4.55)	*p* < 0.001
54–59 (middle)	50	24	0.48	1.88 (1.09–3.27)	0.019
60–75 (high)	51	13	0.25	1	–
Self-efficacy for dentist consultations (SE-DC)					
5–18	49	31	0.63	2.27 (1.34–3.84)	*p* < 0.001
19–21	52	24	0.46	1.65 (0.94–2.90)	0.068
22–25	43	12	0.28	1	–
Self-efficacy for brushing of the teeth (SE-B)					
5–17	57	30	0.53	1.70 (1.02–2.84)	0.032
18–20	45	24	0.53	1.72 (1.02–2.92)	0.035
21–25	42	13	0.31	1	–
Self-efficacy for dietary habits (SE-DH)					
5–17	52	37	0.71	2.52 (1.54–4.12)	*p* < 0.001
18–20	46	17	0.37	1.31 (0.72–2.37)	0.37
21–25	46	13	0.28	1	–

*Crude analysis.

CI, confidence interval; PCR, plaque control record; GSES, general self-efficacy scale; SESS, self-efficacy scale for self-care; SE-DC, self-efficacy for dentist consultation; SE-B, self-efficacy for brushing of the teeth; SE-DH, self-efficacy for dietary habits.

Table 4. Multiple logistic regression analysis of loss to follow-up in long-term periodontal treatment

SESS score	Adjusted odds ratios for loss to follow-up* (95% CI)	*p*-value
15–53 (low)	4.56 (1.11–18.74)	0.035
54–59 (middle)	1.05 (0.36–3.07)	0.935
60–75 (high)	1	–

*Adjusted for age, gender, number of teeth, probing depth (mm), PCR value, PCR improvement rate, and GSES score.

CI, confidence interval; PCR, plaque control record; GSES, general self-efficacy scale; SESS, self-efficacy scale for self-care.

patient behaviour during complete periodontal treatment and continued behaviour for long-term periodontal treatment. For short-term active periodontal treatment, patients consult a dental clinic to resolve their chief complaint. For long-term periodontal treatment, on the other hand, patients consult a dental clinic for ongoing maintenance and promotion of oral health without any specific oral problems. Eating habits and continued long-term periodontal treatment are considered to originate from the same health care beliefs systems. Therefore, SE-DH may be more appropriate for application in the long-term than the short-term with regard to dental consultation.

General self-efficacy is task-specific self-efficacy that is generalized to other situations. Several reports have noted a significant relationship between general and task-specific self-efficacy (Woodruff & Cashman 1993, Kakudate et al. 2007, 2008). In the present study as well, the SESS was found to be significantly related to the GSES and loss to follow-up for periodontal treatment. However, the GSES was not able to predict this loss to follow-up. Given that previous studies have also suggested that task-specific self-efficacy is a better predictor of performance than general self-efficacy (LaGuardia & Labbé 1993, Stanley & Murphy 1997, Kakudate et al. 2008), we consider the results of our present study to be reasonable.

We observed here that younger patients tended to become lost to follow-up for long-term periodontal treatment more frequently than older patients, a finding supported by the results of previous studies (Novaes et al. 1996, Novaes Jr. & Novaes 1999). In their analysis of a group of 874 patients from a private practice, Novaes Jr. & Novaes (1999) found that patients aged ≤40 years were more likely to be non-compliant than those aged >40 years, and the rate of non-compliance decreased inversely with increasing age. In this study, no association was noted between gender and loss to follow-up for periodontal treatment, a finding also supported by past studies (Novaes Jr. et al. 1996, Novaes Jr. & Novaes 1999). However, the other factors such as educational and socioeconomic level, which were not examined in this study, might have skewed the result. Therefore, the association of age and gender might be influenced by other unexamined factors.

We recently developed a psychological approach involving a six-step method for enhancing self-efficacy to improve oral care, known as the periodontal patient's education programme,

and reported on its effectiveness (Kaku-date et al. 2009). Patients who received intervention using this method after receiving traditional oral hygiene instruction had significantly higher self-efficacy, a lower plaque index, longer brushing duration, and higher frequency of inter-dental cleaning than a control group who received only oral hygiene instruction. Such a psychoeducational approach may also be effective in reducing the number of patients lost to follow-up.

The result of the present study is strengthened by several points. Firstly, periodontal status and diagnosis were carefully determined. Secondly, calibrated researchers performed the periodontal and oral hygiene status. Thirdly, long-term behaviour was followed-up. Finally, reliable and validated scales for self-efficacy measurement were used. However, this study has some limitations and several factors must be considered when interpreting the results of the present study. Since we focused on patients with mild to moderate chronic periodontitis, the relationship between self-efficacy and loss to follow-up for periodontal treatment among patients with severe periodontal disease remains unclear. The self-efficacy of patients with severe chronic periodontitis may differ from that of patients with mild to moderate chronic periodontitis. It is possible that educational and socioeconomic status influence the follow-up to periodontal treatment. However, in this research, neither socioeconomic nor educational status was investigated. Future studies need more information including these variables. In addition, the questionnaire of self-efficacy also has the method of the question in conditional tense (Syrjälä et al. 1999). It is necessary to develop scale that can evaluate self-efficacy for self-care from various dimensions. Furthermore, this study was conducted at one geographical location with only Japanese participants. Future studies are also required to confirm these results among patients with varied backgrounds in the other countries or areas and the other institutions or clinics. In conclusion, assessment of oral health care-specific self-efficacy is effective for predicting loss to follow-up for long-term periodontal treatment. It is also important to assess their oral health care-specific self-efficacy on early visit, as patients who tend to become lost to follow-up can be more easily screened at this point. If low self-efficacy is addressed early and the patients are offered support by the dental staff to enhance their self-efficacy, loss to follow-up for long-term periodontal treatment may be reduced.

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References

Axelsson, P., Nystrom, B. & Lindhe, J. (2004) The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease in adults. Results after 30 years of maintenance. *Journal of Clinical Periodontology* **31**, 749–757.

Bandura, A. (1977) Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review* **84**, 191–215.

Bass, C. C. (1948) The necessary personal hygiene for prevention of caries and periodontoclasia. *The New Orleans Medical and Surgical Journal* **2**, 52–70.

Champion, V., Skinner, C. S. & Menon, U. (2005) Development of a self-efficacy scale for mammography. *Research in Nursing and Health* **28**, 329–336.

Douglass, C. W. (2006) Risk assessment and management of periodontal disease. *Journal of the American Dental Association* **137**, 27s–32s.

Edward, G. C. & Richard, A. Z. (1980) *Reliability and Validity Assessment*, pp. 17–51. London: SAGE Publications.

George, S., Clark, M. & Crotty, M. (2007) Development of the Adelaide driving self-efficacy scale. *Clinical Rehabilitation* **21**, 56–61.

Grossman, H. Y., Brink, S. & Hauser, S. T. (1987) Self-efficacy in adolescent girls and boys with insulin-dependent diabetes mellitus. *Diabetes Care* **10**, 324–329.

Hirschfeld, L. & Wasserman, B. (1978) A long-term survey of tooth loss in 600 treated periodontal patients. *Journal of Periodontology* **49**, 225–237.

Kakudate, N., Morita, M., Fujisawa, M., Nagayama, M. & Kawanami, M. (2007) Development of the self-efficacy scale for self-care (SESS) among periodontal disease patients (in Japanese). *Journal of the Japanese Society of Periodontology* **49**, 285–295.

Kakudate, N., Morita, M. & Kawanami, M. (2008) Oral health care specific self-efficacy assessment predicts patient completion of periodontal treatment: a pilot cohort study. *Journal of Periodontology* **79**, 1041–1047.

Kakudate, N., Morita, M., Sugai, M. & Kawanami, M. (2009) Systematic cognitive behavioral approach for oral hygiene instruction: a short-term study. *Patient Education and Counseling* **74**, 191–196.

Kressin, N. R., Boehmer, U., Nunn, M. E. & Spiro, A. 3rd. (2003) Increased preventive practices lead to greater tooth retention. *Journal of Dental Research* **82**, 223–227.

LaGuardia, R. & Labbé, E. E. (1993) Self-efficacy and anxiety and their relationship to training and race performance. *Perceptual and Motor Skills* **77**, 27–34.

Lanning, S. K., Best, A. M., Temple, H. J., Richards, P. S., Carey, A. & McCauley, L. K. (2006) Accuracy and consistency of radiographic interpretation among clinical instructors using two viewing systems. *Journal of Dental Education* **70**, 149–159.

Little, S. J., Hollis, J. F., Stevens, V. J., Mount, K., Mullooly, J. P. & Johnson, B. D. (1997) Effective group behavioral intervention for older periodontal patients. *Journal of Periodontal Research* **32**, 315–325.

McCaul, K. D., Glasgow, R. E. & Gustafson, C. (1985) Predicting levels of preventive dental behaviors. *Journal of the American Dental Association* **111**, 601–605.

Miyamoto, T., Kumagai, T., Jones, J. A., Van Dyke, T. E. & Nunn, M. E. (2006) Compliance as a prognostic indicator: retrospective study of 505 patients treated and maintained for 15 years. *Journal of Periodontology* **77**, 223–232.

Novaes, A. B. Jr., de Lima, F. R. & Novaes, A. B. (1996) Compliance with supportive periodontal therapy and its relation to the bleeding index. *Journal of Periodontology* **67**, 976–980.

Novaes, A. B. Jr. & Novaes, A. B. (1999) Compliance with supportive periodontal therapy. Part 1. Risk of non-compliance in the first 5-year period. *Journal of Periodontology* **70**, 679–682.

Novaes, A. B., Novaes, A. B. Jr., Moraes, N., Campos, G. M. & Grisi, M. F. (1996) Compliance with supportive periodontal therapy. *Journal of Periodontology* **67**, 213–216.

O'Leary, T. J., Drake, R. B. & Naylor, J. E. (1972) The plaque control record. *Journal of Periodontology* **43**, 38.

Resnick, B., Zimmerman, S. I., Orwig, D., Furstenberg, A. L. & Magaziner, J. (2000) Outcome expectations for exercise scale: utility and psychometrics. *The Journals of Gerontology. Series B. Psychological Sciences and Social Sciences* **55B**, S352–S356.

Rossen, E. K. & Gruber, K. J. (2007) Development and psychometric testing of the relocation self-efficacy scale. *Nursing Research* **56**, 244–251.

Sakano, Y. & Tohjoh, M. (1986) The general self-efficacy scale (GSES): scale development and validation (in Japanese). *Japanese Journal of Behavior Therapy* **12**, 73–82.

Sherer, M., Maddux, J. E., Mercandante, B., Prentice-Dunn, S., Jacobs, B. & Rogers, R. W. (1982) The Self-efficacy scale: construc-

tion and validation. *Psychological Reports* **51**, 663–671.

Smarr, K. L., Parker, J. C., Wright, G. E., Stucky-Ropp, R. C., Buckelew, S. P., Hoffman, R. W., O'Sullivan, F. X. & Hewett, J. E. (1997) The importance of enhancing self-efficacy in rheumatoid arthritis. *Arthritis Care and Research* **10**, 18–26.

Stanley, K. D. & Murphy, M. R. (1997) A comparison of general self-efficacy with self-esteem. *Genetic, Social, and General Psychology Monographs* **123**, 81–99.

Stewart, J. E., Strack, S. & Graves, P. (1997) Development of oral hygiene self-efficacy and outcome expectancy questionnaires. *Community Dentistry and Oral Epidemiology* **25**, 337–342.

Syrjälä, A. M., Kneckt, M. C. & Knuuttila, M. L. (1999) Dental self-efficacy as a determinant to oral health behavior, oral hygiene and HbA1c level among diabetic patients. *Journal of Clinical Periodontology* **26**, 616–621.

Syrjälä, A. M., Ylöstalo, P., Niskanen, M. C. & Knuuttila, M. L. (2004) Relation of different measures of psychological characteristics to oral health habits, diabetes adherence and related clinical variables among diabetic patients. *European Journal of Oral Sciences* **112**, 109–114.

Tedesco, L. A., Keffer, M. A. & Davis, E. L. (1992) Effect of a social cognitive intervention on oral health status, behavior reports, and cognitions. *Journal of Periodontology* **63**, 567–575.

Tedesco, L. A., Keffer, M. A. & Fleck-Kandath, C. (1991) Self-efficacy, reasoned action, and oral health behavior reports: a social cognitive approach to compliance. *Journal of Behavioral Medicine* **14**, 341–355.

Travess, H. C., Newton, J. T., Sandy, J. R. & Williams, A. C. (2004) The development of a patient-centered measure of the process and outcome of combined orthodontic and orthognathic treatment. *Journal of Orthodontics* **31**, 220–234.

Woodruff, S. L. & Cashman, J. F. (1993) Task, domain, and general efficacy: a reexamination of the self-efficacy scale. *Psychological Reports* **72**, 423–432.

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Clinical Relevance

Scientific rationale for the study: No association has yet been established between oral health care-specific self-efficacy and loss to follow-up for long-term periodontal treatment. Here, we examine whether or not oral health care-specific self-efficacy can be used to predict loss to follow-up for long-term periodontal treatment.

Principal findings: Oral health care-specific self-efficacy can predict loss to follow-up for long-term periodontal treatment.

Practical implications: Enhancing self-efficacy may be useful in reducing the number of patients lost to follow-up.