Impact of Various Effects of Smoking in the Mouth on Motivating Dental Patients to Quit Smoking

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Abstract: We explored the impact of addressing personally relevant effects of smoking in the mouth on promoting the motivation to quit in a dental setting at personal and public levels. Stages of behavior change and attempts to quit smoking by smokers were recorded during dental visits. Dentists selected and gave motivational information from 24 topics relevant to a patient's oral health status, risk, or dental treatment. During the dental visit, each topic was presented to patients. Topics of gingival melanin pigmentation and periodontal disease risk were most frequently presented. Progression through stages of behavior change and attempts to quit smoking were observed after presentation of each topic. At a personal level, progression through stages was most frequently observed after the patient was shown an image of pediatric dental caries and smoker's palate, and attempts to quit was most frequently observed after the patient shown an image of the effects of smoking cessation and pediatric dental caries. At the public level, enhancing the motivation to progress through stages and attempts to quit was most frequently observed after the presentation of effects of smoking cessation and discoloration of teeth, although the intensity of enhanced motivation significantly correlated with the frequency of presentation, which was not the highest for these topics. Although various smoking effects on the mouth have potential impact on promoting the motivation to quit, the impact on enhancing motivation is not necessarily consistent at personal and public levels.

Keywords: Motivation, Smoking cessation, Stage of behavior change, Dentist, Oral disease.

INTRODUCTION

The WHO oral health program has strengthened its support of countries that incorporate oral health into tobacco control by evaluating and sharing experiences of a tobacco cessation program [1], and the FDI World Dental Federation (FDI) has urged dental professionals to advise patients to quit smoking [2]. The FDI and WHO jointly published an advocacy guide for oral health professionals that highlights the involvement of both organizations in tobacco control initiatives [3]; therefore, global interest has emerged in more comprehensive interventions to increase smoking cessation in the dental setting.

Motivational information has the greatest impact on behaviour change, provided the information is relevant to a patient's disease status or risk and health concerns [4]. Dental professionals may therefore be able to promote motivation to quit using personalized feedback. Our previous study demonstrated that brief intervention involving feedback on the oral effects of smoking is effective, as a whole, in motivating dental patients: Odds ratios of progression through stages of behavioral change [5] and attempts to quit were 3.1 and 2.2, respectively [6]. Further, tobacco intervention by dental professionals helped smokeless tobacco users and smokers to quit [7-11].

Many effects of smoking occur in the oral cavity. The causality was analyzed for the effects on oral cancer, oral clefts, periodontal disease, root surface caries [12], and premature tooth loss [13]. Other effects in the oral cavity have been reported regarding tooth discoloration [14], gingival and lip pigmentation [15], accumulation of dental calculus [16], oral mucosal lesion [17], and negative treatment outcomes of dental implants [18] and periodontal disease [19]. Passive smoking also has an impact on periodontal disease [20], early childhood dental caries [21, 22] and gingival pigmentation in children [23]. Dental professionals can therefore choose appropriate topics for administering effective feedback to smokers. However, frequency of these symptoms likely varies greatly. In general, treatment of dental caries and periodontal disease as well as prosthetic treatment due to tooth loss were performed more frequently than treatment of oral mucosal lesions, including oral cancer and periodical dental check-ups in Japan. Information about the effectiveness of each symptom for the personalized feedback on promoting motivation to quit would be helpful for dental professionals, since many effects of smoking appear in the mouth.

Dentists are ideally placed to promote quitting, because many of their patients consider themselves to

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E-ISSN: 1929-6029/13

be perfectly healthy, allowing dentists to explain the impact of tobacco on oral health [24]; therefore, addressing various effects on promoting motivation is important to increase frequency of success in smoking cessation in the dental setting. Consequently, smoking-related fatal diseases can be prevented in addition to prevention of progression of dental diseases and improvement of the effects of dental treatments. Although feedback on personally relevant smoking topics in the mouth is effective in promoting quitting overall, the impact of various effects may work differently at personal and public levels, since the oral effects of smoking have diverse prevalence and properties that may affect motivation. However, until now, no studies have addressed the impact of various effects of smoking in the mouth on promoting the motivation to quit.

Here, in order to enhance the incorporation of oral health into tobacco control, we explored the impact of addressing various effects of smoking on the mouth on promoting the motivation to quit in a dental setting at personal and public levels.

SUBJECTS AND METHODS

The study protocol was approved by the Ethics Committee of Fukuoka Dental College. We retrospectively analyzed records from a previous intervention study [6]: namely, the records of 248 patients aged 20 years or older who visited 35 dental clinics, including information on a brief intervention for smoking cessation and the stages of behavior change during dental visits (Table **1**). Intervention for smoking cessation in the present study was conducted as follows: Patients were briefly provided feedback involving the presentation of oral health effects personally relevant to smoking utilizing a color chart consisting of graphics with messages and information about nicotine replacement medicine. Content of the feedback in the brief intervention was grouped in advance into 24 representative topics (Table **2**). The topics presented to the patient were recorded at each visit, and intervention continued unless dental treatment was completed prior to the end of the six-month experimental period.

The stages of behavior change in smoking cessation were recorded *via* a standardized questionnaire with some modifications at the first and final visits to assess motivation for behavior change: a pre-contemplation stage lacking interest in quitting, a pre-contemplation stage with interest in quitting, a contemplation stage, and a preparation stage. Attempts to quit were also surveyed during the dental visits.

The main outcome measures were the percentage of patients motivated by the topic with respect to progression through the stages of behavior change and attempts to quit. Motivating force on the patient and public was estimated based on the intensity of the motivating force, calculated by dividing the number of motivated patients by that of patients who were presented the topic and by that of all patients, respectively, as:

Motivating force on the patient (%) = number of motivated patients / number of patients who were presented topic x 100

and

Motivating force on the public (%) = number of motivated patients / number of all patients x 100.

The motivating force at the patient and public levels indicate impact on personal motivation and reach of the impact to the public, respectively.

While clinicians tend to prefer to broach topics with a higher level of motivating force on patients, topics with a higher level of motivating force on the public have more potential to increase frequency as well as success of smoking cessation on the whole. Therefore, topics with a higher level of motivating force on both patients and the public could be potentially effective in enhancing motivation and increasing numbers of successful quitters in the dental setting that would have significant impact on tobacco control. Scattergrams were plotted between variables of motivational intensity at public and personal levels to identify topics potentially useful in promoting motivation at both levels. The association of promoting motivation at the public level with the frequency of presentation of each topic was evaluated utilizing the correlation coefficient. Significance was set at 5%.

RESULTS

Patients visited 4.7 ± 2.9 times on average (± standard deviation [S.D.]), and the number of topics presented to patients was 3.3 ± 2.1 (Table **1**). Before the intervention, the distribution of stages of behavior change in smokers was 13.3% in pre-contemplation lacking interest in quitting, 55.2% in pre-contemplation with interest in quitting, 20.2% in contemplation, and 11.3% in preparation. Overall, 22.6% and 12.1% of

Table 1: Characteristics of 248 Patients and the Brief Intervention

Characteristics	N	%
Gender		
Male	173	70.0
Female	75	30.0
Age (years)		
≤29	55	22.2
30–39	56	22.6
40–59	101	40.7
≥60	36	14.5
Stage of behavior change for smoking cessation		
Precontemplation stage lacking interest in quitting	33	13.3
Precontemplation stage with interest in quitting	137	55.2
Contemplation stage	50	20.2
Preparation stage	28	11.3
History of smoking		
Duration of smoking (years)	24.9 ± 14.4 (Mean ± S.D.)	
Cigarettes per day (number)	18.2 ± 8.7 (Mean ± S.D.)	
Intervention		
Number of topics presented per patient	3.3 ± 2.1 (Mean ± S.D.)	
Number of dental visits per patient	4.7 ± 2.9 (Mean ± S.D.)	
Percentage of patients who progressed through stages	22.6%	
Percentage of patients who attempted to quit	12.1%	

patients progressed through the stages of behavior change and attempted to quit, respectively.

All topics were presented to promote the motivation to quit, and 17 topics were presented at least twice per patient. Gingival melanin pigmentation was presented to the most patients (31.9%; Table **2**), followed by periodontal disease risk (29.0%) and discoloration of teeth (27.0%). Gingival pigmentation was also presented to relatively young patients (35.9 years old on average). The topic of failure of dental implants was used for the smallest population (3.6%), and those of smoker's lip and palate and associations with passive and maternal smoking were also discussed with a limited number of patients (n<15).

Motivational intensity of progression through the stages of behavior change exceeded 10% for all topics at the personal level. Topics with an intensity score of more than 30% that were presented utilizing a color chart consisting of graphics and messages were the association of pediatric caries with passive smoking (#19 as the rank of presentation regarding number of patients, 41.7% for the motivational intensity of progression through the stages), smoker's palate (#23, 40.0%), premature tooth loss (#11, 36.8%), gingival abscess (#14, 35.7%), effect on periodontal treatment (#9, 31.0%) and effects of smoking cessation (#4, 30.2%). Of note, the frequency of presentation of the top 4 topics that were ranked regarding the motivational intensity of progression through the stages fell below the frequency of the 10th topic.

Motivational intensity of attempts to quit at the personal level varied in the range 6.3%-26.4%. Topics with an intensity score of more than 20% were the effects of smoking cessation (#4, 26.4%) as well as and associations of pediatric caries (#19, 25.0%) and periodontal disease risk (#22, 20.0%) with passive smoking. Failure of dental implants (#24, 11.1%) and gingival melanin pigmentation (#1, 6.3%) had the lowest intensity scores in the progression through stages and attempts to quit, respectively.

Table 2: Number of Patients (%) who were Presented Each Topic and those who were Motivated

Rank of the number of patients presented, topic regarding the mouth	Patients presented topic			Patients motivated to…			
				…progress through stages[1]		…attempt to quit	
	n	%	Age[2]	n	%	n	%
1, Gingival melanin pigmentation	79	31.9	35.9±12.6	14	17.7	5	6.3
2, Periodontal disease risk	72	29.0	45.7±14.8	14	19.4	7	9.7
3, Discoloration of teeth	67	27.0	44.7±13.7	15	22.4	10	14.9
4, Effects of smoking cessation	53	21.4	43.7±14.9	16	30.2	14	26.4
5, Susceptibility to infection	51	20.6	44.8±14.0	9	17.6	6	11.8
6, Oral malodor	50	20.2	40.2±14.0	10	20.0	6	12.0
7, Oral cancer risk	46	18.5	44.2±15.4	13	28.3	5	10.9
8, Dental calculus	45	18.1	43.9±14.2	8	17.8	4	8.9
9, Effect on periodontal treatment	42	16.9	47.9±12.5	13	31.0	6	14.3
10, Change in taste	39	15.7	44.1±14.1	7	17.9	4	10.3
11, Premature tooth loss	38	15.3	49.1±15.8	14	36.8	5	13.2
12, Discoloration of restoration	36	14.5	40.3±15.3	6	16.7	3	8.3
13, Effect on restorative and prosthetic treatment due to premature tooth loss	30	12.1	46.2±15.2	6	20.0	2	6.7
14, Gingival abscess	28	11.3	42.6±14.0	10	35.7	5	17.9
15, Leukoplakia	25	10.1	46.2±14.9	5	20.0	2	8.0
16, Prolonged wound healing following tooth extraction	22	8.9	43.1±16.2	6	27.3	4	18.2
17, Suppression of gingival bleeding	22	8.9	38.6±13.9	4	18.2	2	18.2
18, Smoker's lip	13	5.2	42.6±14.3	3	23.1	1	7.7
19, Pediatric caries[3]	12	4.8	39.4±13.2	5	41.7	3	25.0
20, Gingival pigmentation[3]	12	4.8	40.1±14.5	2	16.7	1	8.3
21, Risk of cleft lip and palate[4]	11	4.4	35.9±14.3	2	18.2	2	18.2
22, Risk of periodontal disease[3]	10	4.0	46.6±13.4	2	20.0	2	20.0
23, Smoker's palate	10	4.0	46.8±13.6	4	40.0	1	10.0
24, Failure of dental implant	9	3.6	43.6±14.4	1	11.1	1	11.1

[1]Stages of smoking cessation: precontemplation stage lacking interest in quitting, precontemplation stage with interest in quitting, contemplation, preparation and quitting attempts; [2]Mean age of patients (± standard deviation); and association with [3]passive and [4]maternal smoking.

The intensity scores at a personal level were plotted against those at a public level in scattergrams by each topic (Figure **1**). Twelve topics with a higher intensity score at the public or personal level were identified as indicators of progression through stages (Figure **1A**) and attempts to quit (Figure **1B**).

At the personal level, progression through stages and attempts to quit were observed most frequently after presentation of pediatric dental caries (#19, 41.7%) and smoker's palate (#23, 40.0%), and the effects of smoking cessation (#4, 26.4%) and pediatric dental caries (#19, 25.0 %), respectively. At the public level, enhanced motivation was observed most frequently after presentation of the effects of smoking cessation (#4, 6.5% and 5.6%) and discoloration of teeth (#3, 6.0% and 4.0%) regarding progression through stages and attempts to quit, respectively. Topics of the effects of smoking cessation (#4) and premature tooth loss (#11) were distinctive for promoting motivation at both public and personal levels.

Frequency of presentation was significantly correlated with both indicators of promoting motivation for progression through stages of behavior change and

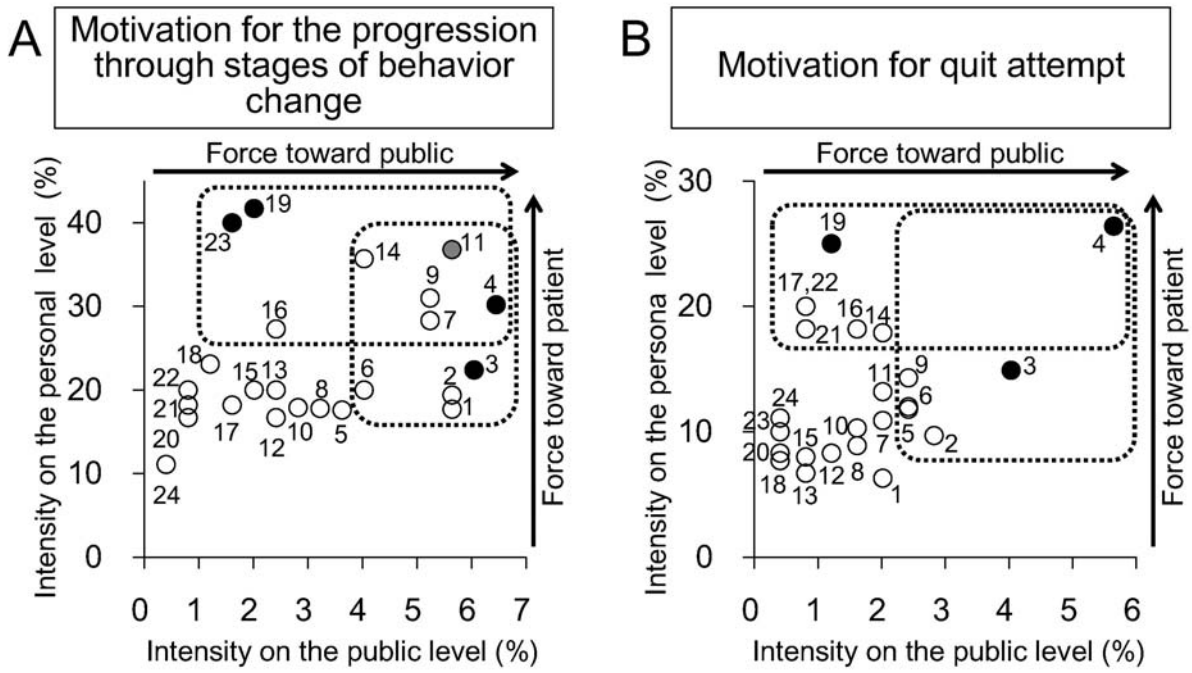

Figure 1: Scattergrams of intensity of motivating force at public and personal levels. Motivating force was evaluated based on (**A**) progression through stages of behavior change and (**B**) attempts to quit. The motivating force at the patient and public levels indicate impact on the personal motivation and reach of the impact to the public, respectively. Mode of the intervention for smoking cessation was provision of feedback involving presentation of oral health effects personally relevant to smoking utilizing a color chart consisting of graphics with messages and information about nicotine replacement medicine. Content of the feedback was grouped in advance into 24 representative topics regarding effects of smoking on the mouth. The number beside each circle corresponds to the topic presented in Table **2**. Closed circles indicate topics having substantially high levels of motivating force on the public or patient among those with higher levels of motivating force (within dotted boxes).

for quit attempt at the public level ($r = 0.873$ and $r = 0.731$, respectively, $P<0.001$, data not shown).

DISCUSSION

Dental professionals touched on a number of topics related to the effects of smoking on the mouth to promote motivation to quit smoking. Since intensity scores exceeded 10% for all topics in progression through the stages of behavior change, each topic may have potential for promoting motivation. Collectively, brief intervention involving feedback on the oral effects of smoking was effective [6].

Promoting the motivation to quit at the public level significantly correlated with the frequency of presentation; therefore, topics that are frequently presented to promote motivation and have a high intensity of motivating force at the personal level may have potential to increase smoking cessation in the dental setting at the population level. In the present study, topics regarding the effects of smoking cessation and premature tooth loss proved potentially useful in enhancing the motivation to quit, as practitioners may experience greater concern in promoting motivation at a personal level versus a public one. Further, dental patients may be more concerned with retention of their teeth and consequently more open to intervention on this topic due to the “8020 Movement”, a program promoting retention of 20 teeth till 80 years of age which has been the national objective for oral health since 1989 in Japan. Tooth discoloration was presented to the third-most patients, and presenting this topic enhanced motivation the second-most intensively in the public, a finding which agreed with those of previous studies that suggested similar effects of presenting discoloration of teeth on promoting the intention to quit [25, 26].

The frequency of presentation varied greatly by topic and may depend on the prevalence of oral diseases and symptoms. The prevalence of gingival melanin pigmentation has been found to be markedly high (83%) in Japanese male smokers [15], and while this topic had the lowest motivating force for attempts to quit at a personal level in the present study, the frequency of presentation was the highest among all topics. Motivating force for attempts to quit fell in the middle at the public level. Given that the topic of gingival melanin pigmentation was used in relatively young smokers who would likely experience more

benefit following quitting than older smokers, the presentation of this topic may have a high public health impact.

The topic of periodontal disease risk was the second-most frequently presented, and several topics with high motivational intensity were related to periodontal disease. This topic should be presented to more patients in dental than medical settings at an earlier age before suffering smoking-associated fatal diseases. Discussing mucosal lesions may work in a similar manner to reduce incidence of oral cancer that is also fatal disease and would be suffered in later life. Topics related to periodontal disease, oral cancer risk and discoloration of teeth should be presented efficiently to increase smoking cessation at the public level.

An average of at least three topics was presented per patient during dental visits; as such, the impact of presenting a combination of topics should be taken into account. The motivational skills of practitioners are important factors that could potentially influence behavior change in patients [27]. We must cautiously consider the effects of bias due to the motivational skills of dental professionals on generalizing the findings, although any such influence would likely be negligible due to the brevity of intervention. Dental professionals are excellent practitioners who are trained in basic motivational tactics to effect behavioral change in oral health during their undergraduate education; therefore, implementation of a tobacco cessation program in dental clinics would be enhanced by dissemination of the information about the impact of various effects of smoking in the mouth on promoting the motivation to quit.

In the present study, the impact of addressing various effects of smoking on the mouth on promoting the motivation to quit in a dental setting was explored at personal and public levels. Analytical statistics were not applied to compensate for a potential bias of selection because of the properties of sample extraction. Due to limited number of subjects who were presented each topic, we did not conduct analyses to evaluate the role of any possible confounding or interaction, especially, effects of covariates such as tobacco use history, past quit attempts, and baseline motivational level. Adjustments for possible confounders in each topic would improve the accuracy of interpretation with respect to generalization of the results even though the present study employed simple mode of brief intervention, since the oral effects of smoking have diverse prevalence and properties that may affect motivation.

Since the main outcome measures were analyzed for relationships within the sample population, the following conclusions may be drawn for the entire population: Various oral effects on the mouth of smokers as presented by oral health professionals demonstrated potential impact on their motivation to quit. Motivating forces of topics regarding the mouth appeared to differ at personal and public levels, except for the topic of the effects of smoking cessation, which had high potential for motivating force at both personal and public levels, as well as the topic of premature tooth loss. Taken together, these results suggest that the impact on enhancing motivation rarely consistent at personal and public levels.

ACKNOWLEDGEMENTS

This work was supported by a Fukuoka Dental College Grant for Education and Research (2011-2012) and JSPS KAKENHI Grant Number 24593182. No conflicts of interest were declared by the authors.

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Received on 03-12-2012 Accepted on 01-01-2013 Published on 31-01-2013

http://dx.doi.org/10.6000/1929-6029.2013.02.01.05