Utilization of Denture Adhesives and the Factors Associated with its Use: A Cross-Sectional Survey

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Abstract

Background An increase in the number of elderly edentulous patients likely leads to a greater demand for complete or partial dentures. However, there are some related problems such as retention and stability in both complete and partial dentures. In order to solve these problems, denture adhesives are widely utilized by denture wearers. Since denture adhesives have positive and negative features, dentists need to know the kinds of denture adhesive users for the purpose of giving instruction to denture wearers on how to use denture adhesives properly and effectively. The aim of this study was to examine the utilization of denture adhesives and to determine the factors associated with such use through a web-based survey system.

Methods Seven closed-ended questionnaires were developed for the web-based survey system. A table on the utilization of denture adhesives by denture wearers was first presented. Thereafter, Fisher's exact tests were performed to determine the difference in the denture adhesive usage rate by gender, type of denture, last dental visit, and smoking. Moreover, multivariate-adjusted logistic regression analysis was performed with denture adhesive use or non-use as the dependent variable and the other items as independent variables. Statistical analyses were performed for all denture wearers, complete denture wearers, and partial denture wearers respectively.

Results A total of 1470 denture wearers in Japan participated in this study. Of these, 318 used denture adhesives, while 212(66.7%) used cream; 74(23.3%) used home liner; 25(7.9%) used powder; 4(1.3%) used sheet; 3(0.9%) used several types. Fisher's exact test revealed that the ratios of using denture adhesives were significantly higher for complete denture wearers ($p<0.001$), last dental visit within one year ($p=0.005$) and smokers ($p=0.005$). For partial denture wearers, the ratio was significantly higher in smokers ($p=0.262$). Multivariate adjusted logistic regression revealed that denture adhesive use or non-use were significantly associated with the type of denture and smoking in all denture wearers, and just smoking in partial denture wearers.

Conclusions In all denture wearers, complete denture wearers and smokers significantly use denture adhesives. On the other hand, smokers significantly use denture adhesives for partial denture wearers.

Background

The proportion of the older population in Japan has been increasing in the past years (1). The Japanese government projected that the proportion of older persons above 65 years of age will further increase to 38.4% by 2065 (1). With the ever-increasing elderly population, there will inevitably be greater challenges for the delivery of oral health care. Despite progress in dentistry, tooth loss that comes with old age is still a reality(2,3). There is an expectation of complete edentulism in 2.9% to 58% of the adult population internationally (4, 5). With the increase in the number of elderly edentulous patients, there is likely to be a greater demand for complete or partial dentures. Some of the main problems posed by complete denture wearers involve retention, stability and function. These are important indicators in estimating masticatory

ability and oral health related quality of health (6). Furthermore, functional disturbances as well as psychological problems were found in complete denture wearers as well (7). More than 40% of complete denture wearers complained of mastication discomfort or pain and looseness of their dentures (8). There were also some problems encountered in partial dentures. The most frequently encountered complication in partial removable dentures involved the loss of retention – causing dissatisfaction of patients related to chewing ability (9). Needless to say, denture wearers with denture problems should visit their respective dental clinic to remedy such problems. However, some elderly people have difficulty in visiting dental clinics because of their physical disabilities (10).

In order to solve these common problems, denture adhesives are being utilized widely by denture wearers. Program directors of undergraduate complete dentures curriculum in US dental schools agreed that denture adhesives are used to improve the overall performance of complete dentures (11). Such use also aids in psychological satisfaction, thus improving the quality of life (12). Denture adhesives improved well-fitting denture stability (13), speech (14), mastication (14), mandibular movement during chewing (15) , maximum bite force until denture dislodgement (16, 17) and oral health-related quality of life (18). Experts also use denture adhesives in the clinical process when making dentures, particularly in study base fixation, bite registration, and improvement of the accuracy of denture try-ins (19). The use of denture adhesives significantly increases the force required to displace mandibular free-end saddle partial dentures (20) .

However, denture adhesives also have some negative aspects. Program directors of US dental schools agreed that denture adhesive can contribute to residual ridge resorption (11). Moreover, denture adhesives could promote the development of oral diseases/conditions such as denture stomatitis, candidiasis, and oral flora imbalance (11). Some unpleasant factors concerning its usage involved the difficulty of removal from oral tissues and dentures (21), which causes poor oral hygiene.

Since denture adhesives have their positive and negative aspects, they must be used in an appropriate manner with accurate knowledge. Thus, dentists need to know the kinds of denture adhesive users for the purpose of instructing them on how to use denture adhesives properly and effectively.

However, previous studies were only small surveys with under 150 participants (22) and medium scale surveys with 449 participants[23]. These studies did not obtain information on factors associated with the use of dental adhesives. Therefore, dentists do not know about denture adhesives users in detail. Thus, we performed a large-scale survey with numerous participants using a web-system. The aim of this study was to survey the utilization of denture adhesives of denture wearers and to determine the factors associated with the use of such denture adhesives.

Methods

The characteristics of participants

We used the services of a web-survey company (OGIS-RI Co., Ltd.) to develop a web-based survey system for denture adhesive users in Japan. The company provided access to 92747 people who were registered previously to the web-based survey system. We selected the participants for this study from respondents of the web system. Those without missing answers to the survey were chosen, subject to the criteria that they were removable denture wearers above 55 years old.

Web-questionnaire

We developed an electronic closed-ended questionnaire in Japanese, consisting of 7 questions. The following information were obtained: 1) *gender*, 2) *age*, 3) *denture wearer or not*, 4) *the type of denture* (complete denture or partial denture), 5) *denture adhesives user or not*, 6) *last dental visit* under *one year or above*, and 7) *smoking or not*.

Statistical analysis

Information on the utilization of denture adhesives by denture wearers was first presented. Thereafter, Fisher's exact tests were performed to determine the difference in denture adhesive usage rate by gender, type of denture, last dental visit, and smoking. Moreover, multivariate adjusted logistic regression analysis was performed with denture adhesive use or non-use as the dependent variable and the other items as independent variables. These analyses were performed again for complete and partial denture wearers respectively. The level of statistical significance was set at p=0.05. Data were analyzed using JMP version 8.0 (SAS Institute, Cary, NC, USA).

Results

Characteristics of participants

Out of 92747 persons asked to answer the survey, only 23424 persons replied using the web-survey system. Among these replies, only 5935 had valid answers without any missing values. There were a total of 1470 denture wearers obtained and analyzed from this survey. Characteristics of these 1470 participants are shown in Table 1.

Table 1. Characteristics of the participants

		All denture wearers		Complete denture wearers		Partial denture wearers	
N		1470		386		1084	
age	Median Year (Min.-Max.)	70 (55-89)		71 (55-89)		70 (55-86)	
Gender							
	Male	1153	(78.4%)	331	(85.7%)	822	(75.8%)
	Female	317	(21.6%)	55	(14.3%)	262	(24.2%)
Last dental visit							
	under 1 year	1053	(71.6%)	202	(52.3%)	851	(78.5%)
	over 1 year	417	(28.4%)	184	(47.7%)	233	(21.5%)
Smoking							
	non-smoker	1189	(80.9%)	288	(74.6%)	901	(83.1%)
	smoker	281	(19.1%)	98	(25.4%)	183	(16.9%)

Denture adhesive utilization

The survey results on denture adhesive use and the corresponding type of denture adhesives utilized are shown in Table 2.

Table 2. Utilization survey of denture adhesives

	All denture wearers		Complete denture wearers		Partial denture wearers	
Denture adhesive						
user	318	(21.6%)	184	(47.7%)	134	(12.4%)
non-user	1152	(78.4%)	202	(52.3%)	950	(87.6%)
Type of denture adhesive						
cream	212	(66.7%)	122	(66.3%)	90	(67.2%)
home liner	74	(23.3%)	43	(23.4%)	31	(23.1%)
powder	25	(7.9%)	14	(7.6%)	11	(8.2%)
sheet	4	(1.3%)	3	(1.6%)	1	(0.7%)
several types user	3	(0.9%)	2	(1.1%)	1	(0.7%)

Related factors for denture adhesive use

Fisher's exact tests revealed that for all denture wearers, the ratios of using denture adhesives were significantly higher for complete denture wearers ($p<0.001$), last dental visit under 1 year ($p<0.001$), and smokers ($p=0.005$). On the other hand, for partial denture wearers, the ratio was significantly higher in smokers ($p=0.262$). The complete results on the usage ratio are shown in Table 3.

Table 3. The usage ratio of denture adhesives

	All denture wearers		Complete denture wearers		Partial denture wearers	
		p-Values		p-Values		p-Values
Gender						
Male	22.5%	0.14	49.6%	0.08	11.6%	0.16
Female	18.6%		36.4%		14.9%	
Last dental visit						
under 1 year	**18.6%**	**<0.001**	49.5%	0.48	11.6%	0.18
over 1 year	**28.5%**		45.7%		15.0%	
Smoking						
non-smoker	**19.8%**	**<0.001**	46.2%	0.35	**11.3%**	**0.026**
smokers	**29.5%**		52.0%		**17.5%**	
Type of denture						
partial denture	**12.4%**	**<0.001**				
complete denture	**47.7%**					

Bold faces are significant variables in Fisher's exact tests ($p<0.05$)

Multivariate-adjusted logistic regression revealed that denture adhesive use or non-use were significantly associated with the type of denture and smoking in all denture wearers, and smoking in partial denture wearers. These results are shown in Table 4.

Table 4. Multivariate adjusted logistic regression analyses using denture adhesive use or non-use as dependent variables.

	All denture wearers		Complete denture wearers		Partial denture wearer	
Independent Variables	OR (95%CI)	p-Values	OR (95%CI)	p-Values	OR (95%CI)	p-Values
Gender						
male	1.00		1.00		1.00	
female	1.03 (0.73-1.47)	0.84	0.54 (0.30-1.00)	0.05	1.45 (0.959-2.21)	0.08
Last dental visit						
under 1 year	1.00		1.00		1.00	
over 1 year	1.03(0.77-1.39)	0.85	0.81 (0.540-1.22)	0.31	1.29 (0.85-1.97)	0.23
Smoking						
non-smoker	1.00		1.00		1.00	
smoker	**1.44 (1.04-2.00)**	**0.03**	1.22 (0.761-1.95)	0.41	**1.72 (1.09-2.69)**	**0.02**
Type of denture						
partial denture	1.00					
complete denture	**6.36 (4.78-8.47)**	**<0.001**				

OR (95%CI): Odds ratio (95 % confidence interval)

Bold faces are significant variables (p<0.05)

Discussion

This current study uses the largest survey among existing studies relating to denture adhesives using a web-based survey system. The substantial proportion of denture wearers, which were 1470 persons, were investigated for the use of denture adhesives. As a result, we revealed the utilization of denture adhesives and the factors related to use or non-use of denture adhesives.

Out of the 5935 participants who answered to this web survey, 1470 participants were denture wearers. Among the 1470 participants, 380 participants were complete denture wearers and 1084 participants were partial denture wearers. The number of participants greatly differed by gender. There were 1153 male and 317 female participants. This gender gap was because participants could freely participate and no rule on gender was specifically determined for this study. Previous studies showed that general and oral health literacy and their related factors differed between genders (24, 25) Therefore, in the same way, the related factor to denture adhesive use or non-use is possibly different between genders. Thus, we have to recognize that the gender gap may affect the results of this study. As this study was a web-based survey, it was expected from the survey that there would be a limitation regarding computer-use for older age groups. Therefore, majority of the participants may come from the younger age groups. However, the group of participants was still widely distributed in this study. The median age was 70, while the maximum and minimum age were 89 and 55 respectively. Therefore, an analysis of a wide age group was possible in this particular study.

There were 318 (21.6%) out of 1470 denture adhesives users in this study as shown in Table 2. Coates reported that 6.9% of participants in his study used denture adhesive (22). On the other hand, Polyzois reported that 26% and 20% from Greek and Dutch participants respectively used denture adhesives (23). From the 318 denture adhesives users in this study, 212(66.7%) used cream; 74(23.3%) used home liner; 25(7.9%) used powder; 4(1.3%) used sheet; 3(0.9%) used several types. Cream-type user was the majority with home liner users coming in second. These usage rates of the type of denture adhesives showed the same trend in complete and partial denture wearers as shown in Table 2.

To investigate the difference of usage rate of denture adhesives by gender, the type of denture, last dental visit and smoking, Fisher's exact probability tests were performed. Thereafter, the type of denture ($p<0.001$), last dental visit ($p<0.001$), and smoking ($p<0.001$) was significant, respectively (Table 3). Therefore, it may be concluded that the usage rate of denture adhesive is higher in complete denture wearers than those of partial denture wearers, those who visited dental clinic within a year than those who did not visit within a year, and smokers than non-smokers. The usage rate of denture adhesives differs greatly between partial denture wearers (12.4%) and complete denture wearers (47.7%). Moreover, multivariate adjusted logistic regression analysis using age, gender, the type of denture, last dental visit, and smoking, revealed that complete denture wearers (OR:6.36 [95%CI 4.80-8.47], $p<0.001$) and smokers (OR:1.44 [95%CI 1.04-2.00], $p=0.03$) were significant factors (Table 4). This means that complete denture wearers used denture adhesives about 6.36 times more than partial denture wearers. One of the main effects of denture adhesive is the improvement of retention(26). Needless to say, retentive mechanism is different between complete and partial denture with retention mechanism such as clasps. We considered the related factors of using denture adhesive to be different between complete and partial denture wearers. We then performed analyses of complete and partial denture wearers separately in further statistical analyses.

In complete denture wearers, to investigate the difference of usage rate of denture adhesives by gender, type of denture, last dental visit, and smoking, Fisher's exact probability tests were performed

(Table 3). Moreover, multivariate adjusted logistic regression analysis was also performed (Table 4). Though both tests don't show statistically significant results, the logistic regression showed that female participants had proclivity not to use denture adhesive (OR: 0.5 [95%CI 0.3-1.00], p=0.05)(Table 4). Although there was not enough evidence, males have a probability of using denture adhesive more, which might be caused by confounding factor of some male backgrounds. Further studies are needed to reveal the various related factors in using denture adhesives in complete denture wearers.

Next, we performed statistical analyses only in partial denture wearers. Fisher's exact probability tests revealed that smokers used denture adhesive more (Table 3). Furthermore, multivariate adjusted logistic regression analysis revealed smoking was a statistically significant factor (OR: 1.72 [95%CI 1.09-2.69], p=0.019). Moreover, smokers used denture adhesive 1.72 times more than non-smoker (Table 4). Smoking can cause reduced salivary flow or dry mouth – called xerostomia (27). This is one of the reasons why smokers who are partial denture wearers use denture adhesive. Saliva plays an important role for dentures. Stimulated salivary flow rate was significantly related to masticatory performance in Eichner group C denture wearers (28). The other reason for smokers using denture adhesive is alveolar bone resorption. There is an irreversible alveolar bone loss during the progression of periodontal disease. Smoking cigarettes is one of the main risk factors in the development of periodontal disease (29).

Conclusions

This is the largest and most significant survey conducted relating to denture adhesives. This particular study had 1470 participants and used a web-based survey system to gather results. The usage rate of denture adhesives in this web-based survey was 21.6% in all denture wearers, 47.7% in complete denture wearers, and 12.4% in partial denture wearers. The usage rates by the type of denture adhesives in descending order were cream, home liner, powder, sheet, and several-types user. In all denture wearers, complete denture wearers and smokers significantly used denture adhesives. On the other hand, in partial denture wearers, smokers significantly used denture adhesives.

We recognize some limitations in the scope of our study. First, it was sampling bias. This study used web-based system, and therefore all participants were limited to those who could access the internet. As a result, participants were considered to be independent elderly who didn't have severe problems related to activities of daily living. Second, a web-survey system can correct subjective answers of questionnaire by participants, but cannot correct objective data measured by examiner, such as objective masticatory performance and denture condition. Taking these limitations into consideration, this is the first study that investigates utilization of denture adhesive in 1470 denture wearers. Moreover, we partially revealed related factors to denture adhesive use. That is to say, in all denture wearers, smokers and complete denture wearers use more denture adhesive. Moreover, smokers used more denture adhesive if they were partial denture wearers. Therefore, dentists have to see these patients more carefully in consideration of the possibility of use of denture adhesives and provide appropriate guidance on the effective and

appropriate use of denture adhesives. Further studies should be performed to explain the related factors of denture adhesive use in complete denture wearers. Moreover, the related factors of denture adhesive use should be examined in greater detail to combine web-survey data with data that was directly examined.

Declarations

Ethics approval and consent to participate

The Ethical Committee of the Tokyo Medical and Dental University (#-D2018-057) approved the study protocols. All participants provided informed consent using the web-based survey system before their enrolment in the study. Furthermore, the experiments were performed in accordance with the guidelines in the Helsinki Declaration on the use of human subjects for research.

Consent for publication

Not applicable.

Availability of data and materials

All data files are available from the corresponding author upon request.

Competing interests

Though the authors received financial support from Kobayashi Pharmaceutical Co., Ltd., their interpretation of the data or presentation of the information were not influenced by their personal or financial relationship. The authors declare that they have no competing interests.

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Authors' contributions

TMB designed the study and drafted the manuscript. YH performed the data curation and drafted the manuscript. NR and SM were project administrators and reviewed and edited the manuscript. All authors have read and approved the final version of this manuscript.

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