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Original article

Masticatory performance and oral health-related quality of life before and after complete denture treatment

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ABSTRACT

Purpose: To clarify the relationship between masticatory performance and oral health-related quality of life (OHRQoL) before and after complete denture treatment.
Methods: Thirty patients wearing complete dentures were asked to chew a gummy jelly on their habitual chewing side, and the amount of glucose extraction during chewing was measured as the parameter of masticatory performance. Subjects were asked to answer the Oral Health Impact Profile (OHIP-J49) questionnaire, which consists of 49 questions related to oral problems. The total score of 49 question items along with individual domain scores within the seven domains (functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability and handicap) were calculated and used as the parameters of OHRQoL. These records were obtained before treatment and 3 months after treatment. Each parameter of masticatory performance and OHRQoL was compared before treatment and after treatment. The relationship between masticatory performance and OHRQoL was investigated, and a stepwise multiple linear regression analysis was performed.
Results: Both masticatory performance and OHRQoL were significantly improved after treatment. Furthermore, masticatory performance was significantly correlated with some parameters of OHRQoL. The stepwise multiple linear regression analysis showed functional limitation and pain as important factors affecting masticatory performance before treatment and functional limitation as important factors affecting masticatory performance after treatment.
Conclusions: These results suggested that masticatory performance and OHRQoL are significantly improved after treatment and that there is a close relationship between the two. Moreover, functional limitation was found to be the most important factor affecting masticatory performance.

1. Introduction

Restoration of masticatory function is one of the main objectives of dental care; hence, many attempts have been made to evaluate this function. Masticatory performance is an important parameter in evaluating masticatory function objectively. For many years, masticatory performance has been measured using the sieving method; [1] in this method, the subject chews a test food for a specific number of times, and the crushed test food is collected from the oral cavity and divided by sieving according to the degree of crushing. However, because of the complicated and time-consuming nature of this method, other relatively simpler methods have been attempted in recent years. Among them, measurement of the glucose extraction during chewing of gummy jelly has attracted close attention, because of the simple manipulations needed, easy control of hygiene, possibility of standardization of the physical and other properties of the gummy jelly as the test food, and reports of a positive correlation between the masticatory performance as measured by this method and that measured by the sieving method [2].

Oral health-related quality of life (OHRQoL) has been increasingly recognized as an important outcome of dental care. Among OHRQoL measures, Oral Health Impact Profile (OHIP) is most widely known and used to evaluate the effect of dental care [3–13].

Many reports have demonstrated that loss of teeth is associated with a decline of the masticatory performance or OHRQoL and that prosthetic treatment brings about improvements in masticatory performance or OHRQoL [3–30]. It has been reported that the masticatory performance and OHRQoL of patients wearing complete dentures are inferior to those of patients with removable partial dentures or natural dentition [9,13,22,24] and are improved after treatment [3–7,9–12,14–19,21,23,25–28,30]. From the results

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of the previous reports so far, it is predicted to be high probability that improving masticatory function by dental prosthodontic treatment is related to OHRQoL. In order to demonstrate the relationship between masticatory performance and OHRQoL in patients wearing complete dentures, the relationship between these two factors need to be investigated before treatment, where a patient requires new dentures, and after treatment, where a patient is satisfied with new dentures. However, while recent study investigating the relationship between these two factors have found a significant correlation after treatment, they have not found a significant correlation before treatment [13]. Thus, the relationship between the masticatory performance and OHRQoL has not been elucidated to date. Therefore, in this study, we analyzed the masticatory performance and OHRQoL before and after complete denture treatment in order to clarify the relationship between these two parameters in complete denture wearers. To clarify the relationship between masticatory performance and OHRQoL is an attempt to make it possible to infer masticatory performance from OHRQoL, and has clinical values to it.

2. Materials and methods

2.1. Ethics statement

All experimental procedures were approved by the Ethics Committee of Nippon Dental University (NDU-T2012-29). Informed consent was obtained from all subjects after they were received the general nature of the study.

2.2. Subjects

Thirty patients (15 males and 15 females; 68–82 years old; average age, 74.7 years) wearing complete dentures participated in this study. The following inclusion criteria were applied: (1) wearing a pair of complete dentures for at least 3 years, (2) requiring a new pair of complete dentures, (3) recognizing a habitual chewing side.

The patients received complete denture treatment by three prosthodontists with clinical experience for over 20 years.

2.3. Recording method

2.3.1. Masticatory performance

The test food was a cylindrically shaped gummy jelly with a diameter of 14 mm, height of 10 mm, and weight of 2.3 g.

Subjects were asked to chew the gummy jelly on their habitual chewing side for 20 s. After chewing, they were asked to hold 10 ml of distilled water in their mouths for a moment and to spit into a cup with a filter. The cup containing the gummy jelly and the saliva was then filtered, and the filtrate was collected. For evaluating masticatory performance, the glucose concentration in the filtrate was measured as glucose extraction by means of a glucose testing device (GS-2; GC, Tokyo, Japan). The amount of glucose extraction was used as the parameter of masticatory performance.

2.3.2. OHRQoL

OHRQoL was measured using the Japanese version of the Oral Health Impact Profile (OHIP-J49) [31] derived from the English language version (OHIP-49). The OHIP-J49 is composed of 49 question items in the following seven domains: functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. For each question, the subjects were asked how frequently they had experienced the event in the last month. Responses were made on a scale of 0–4 (0 = never; 1 = hardly ever; 2 = occasionally; 3 = fairly often; 4 = very often). Next, the total score of 49 question items and the individual domain scores of seven domains were calculated and used as parameters of OHRQoL.

Masticatory performance and OHRQoL were evaluated before treatment and 3 months after treatment.

2.3.3. Statistical analysis

All the data were analyzed using a statistical software (SPSS for Windows 15.0J, Chicago, IL, USA). First, the parameter of masticatory performance was compared before and after treatment by a paired t-test. Normality was checked by a Kolmogorov–Smirnov test. The parameters of OHRQoL were compared before and after treatment by a Wilcoxon signed-rank test. The presence or absence of a statistically significant correlation between the parameter of masticatory performance and the parameters of OHRQoL was determined by calculating the Spearman's correlation coefficient. Subsequently, stepwise multiple linear regression analysis was performed using the masticatory performance as a dependent variable and the parameters of OHRQoL as independent variables. Calculation of Spearman's correlation and stepwise multiple linear regression analysis were performed twice, before treatment and after treatment. All statistical analyses were performed with significance level set at p values of 0.05.

3. Results

The masticatory performance after treatment was significantly better than that before treatment (Table 1). The parameters of OHRQoL after treatment were significantly lower than those before treatment (Table 2). The masticatory performance was significantly correlated with the total score, functional limitation, pain and physical disability before treatment and with the total score, functional limitation, pain, physical disability and psychological disability after treatment (Table 3). Stepwise multiple linear regression analysis showed functional limitation and pain as the important factors affecting masticatory performance before treatment (Table 4). Furthermore, functional limitation was found to be factor affecting masticatory performance after treatment (Table 5). The value of adjusted R^2 was 0.51 before treatment and 0.24 after treatment. Functional limitation was significantly related to masticatory performance both before and after treatment. Among nine questions regarding functional limitations, treatment resulted in improvement in many subjects for the three items, such as "difficult to chew", "difficult to pronounce", and "dentures not fitting well".

Table 1
Mean values and standard deviations for masticatory performance before and after treatment

	(mg/dL)				
	Before treatment		After treatment		p value
	Mean	SD	Mean	SD	
Masticatory performance	95.0	21.3	173.3	27.6	0.000**

SD: standard deviation
** $p < 0.01$

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