ABSTRACT

Background: The effect of the location of dental implant treatment on treatment outcome, as evaluated by oral health-related quality of life (OHRQoL) assessment, remains controversial.

Purpose: To investigate the association between location of dental implant treatment and change in OHRQoL.

Materials and Methods: A total of 68 subjects received implant treatment in the anterior or posterior region, and completed the Oral Health Impact Profile (OHIP) questionnaire before and after treatment. The change in the OHIP summary score as well as 4 dimension scores were calculated to evaluate effects of implant treatment on OHRQoL.

Results: The mean Oro-facial Appearance score for the anterior group was significantly higher than that of the posterior group (10.4 ± 5.1 and 7.2 ± 3.8, respectively; P < .01; Effect size = .63) at baseline. All questionnaire scores were significantly improved by implant treatment in both groups, with no significant group differences observed at follow-up. Regression analysis revealed a significant association between the location of most anterior implants and change in Oro-facial Appearance score (adjusted R² = .073; P = .015).

Conclusion: Results suggest that the location of dental implant treatment influences OHRQoL impairment and improvement after treatment. This information might be referred to during clinical decision-making.

KEY WORDS: clinical research, partial edentulous, patient satisfaction, implant, oral health-related quality of life, Oral Health Impact Profile, OHIP
INTRODUCTION

It is well recognized that oral health-related quality of life (OHRQoL) assessments of dental treatments are both valid and necessary for comprehensive evaluation of treatment outcomes and it has been well documented that prosthodontic treatment, in general, has positive impact on OHRQoL. However, treatment outcomes may differ depending on the type of prosthesis (removable or fixed, implant, or tooth supported) or the location where the treatment is performed (anterior and/or posterior, maxilla and/or mandible). In fact, the literature generally suggests a better treatment outcome for fixed prostheses than for removable prostheses. Effects of the location of the prosthodontic treatment have also been reported in several studies to be clinically relevant for changes in OHRQoL. One study, which investigated the effects of removable and fixed prosthodontic treatment on the change in OHRQoL in relation to location where treatment was provided, reported that patients who underwent treatment in the anterior region reported higher impairment in pre-treatment OHRQoL, which was improved by both types of treatments; however, removable partial dentures replacing posterior teeth did not result in a significant improvement in OHRQoL. A recent German study reported that the degree of OHRQoL improvement using conventional fixed and/or removable dentures for both anterior and posterior regions was higher than those for the posterior region alone.

Regarding studies examining implant treatment, one investigated QoL in patients with unilateral posterior edentulism, who were treated with implant-retained fixed partial dentures, removable partial dentures, and those who had no treatment, and found a better QoL after implant treatment compared with other groups. Excellent treatment outcome, as evaluated by OHRQoL improvement, with posterior implant-retained fixed dentures has also been reported in other studies. In contrast, one study reported significant OHRQoL improvement with implant for a unilateral posterior free-end edentulous space, whereas no significant difference was observed in the bounded posterior edentulous space. It has also been reported that replacement of missing teeth with single dental implants in molar areas did not necessarily improve perceived oral health, while that in anterior and premolar areas improved it significantly.

These studies generally suggest that the location of prosthodontic treatment is likely to have an influence on OHRQoL. However, there is still controversy regarding how they are related, probably because of inconsistencies in study methodologies, such as sub-group definitions for comparison, or OHRQoL evaluation method. For example, these studies generally used the Oral Health Impact Profile (OHIP) and its single summary scores for evaluation; however, to capture the nature or profile of OHRQoL, multi-dimensional analysis using dimension scores supported by empirical evidence is
recommended.

For these reasons, the present study exclusively recruited patients who received 1 to 3 implants for the anterior region, defined as up to the premolars, and the posterior region, defined as molars only, and explored the change in OHRQoL as evaluated by the OHIP summary and dimension scores. Our null hypothesis was that there is no difference in changes in the magnitude and nature of the OHRQoL between patients who received anterior and posterior implants.

**MATERIALS AND METHODS**

**Subjects and Settings**

Subjects were recruited consecutively at the Department of Prosthodontics and Implant Center at Showa University (Tokyo, Japan) between June 2008 and July 2015, according to the inclusion and exclusion criteria described below. Individuals who were scheduled to receive fixed implant dentures for fewer than three missing teeth in either the maxillary or the mandibular jaw were included. The exclusion criteria were as follows: necessity of bone graft for implant placement; use of removable prostheses in the opposite jaw; previous experience with dental implant treatments; exhibiting acute pain in the oro-facial region; difficulty with completing self-administered questionnaires; and mental instability or other serious disease with marked limitation of physical or mental activity. Among those who participated in the present study, one did not complete the treatment within the study period and one did not visit the clinic after the treatment. The remaining 71 subjects (47 females; mean [±SD] age 53.9 ± 10.6 years) completed the entire study protocol (i.e., responded to pre- and post-treatment questionnaires). Three of these patients, however, were excluded from the analysis because more than half of their data were missing; therefore, data from the 68 remaining subjects (44 females; mean age 53.8 ± 10.8 years) were analyzed.

The subjects were divided into 2 groups depending on the region of the missing tooth/teeth. The anterior group (n = 32) included patients who received treatments for the anterior and/or premolar regions, while the posterior group (n = 36) included those who received treatments for the molar regions (Table 1). The study protocol was approved by the Ethics Committee of Showa University (#2007-29, January 18, 2009). All subjects provided informed written consent before participating in the study.

**Measurement of OHRQoL**

OHRQoL was assessed using the Japanese version of the Oral Health Impact Profile (OHIP-J).15 Patients were asked to answer 49 questions, which queried how frequently oral problems were
experienced in the past month. Responses were scored using a 5-point Likert-type scale (4 = very often; 3 = fairly often; 2 = occasionally; 1 = hardly ever; and 0 = never). OHRQoL was evaluated using the OHIP summary score (range, 0 to 196), in which higher scores indicated more impaired OHRQoL. In addition, in using the 49 questions in the OHIP questionnaire, 4 dimension scores—Oral function, Oro-facial Pain, Oro-facial Appearance, and Psychosocial Impact—were calculated. These dimensions comprised a number of items each: Oral function (10 items); Oro-facial pain (7 items); Oro-facial Appearance (6 items); and Psychosocial Impact (18 items). These 4 dimensions comprised a total of 41 items, excluding 3 that referred to the denture and 5 that could not be classified anywhere among the 49 items.\textsuperscript{16,17} The OHIP questionnaire was administered to each subject before the implant treatment started (baseline) and one month after the final protheses was delivered (follow-up).

**Statistical analyses**

Descriptive statistics were used to calculate the means and standard deviation and distributions of sex, age, and missing teeth. Normal distribution tests (Shapiro-Wilk) showed that the OHIP scores were not normally distributed. Therefore, non-parametric methods were used for all tests. The effects of implant treatment on OHIP summary scores as well as 4 dimension scores for each group were evaluated using the Wilcoxon signed-rank test. The effects of the location of implant treatment on the OHIP scores at baseline and follow-up, and magnitude of change in OHIP scores were evaluated using the Mann–Whitney U test. The calculation of effect size (ES) was performed to determine the strength of change between two intervals and for meaningful magnitude of changes between the two groups, using a procedure and criteria recommended by Cohen.\textsuperscript{18} The difference in OHIP scores between two intervals was calculated and divided by the standard deviation of the first / initial score to yield ES. An ES of 0.2 was defined as small, 0.5 as medium, and 0.8 as large.

To further examine the effect of implant location on treatment effects, multivariate regression analysis was conducted between the location of the most anterior implant placed and the magnitude of the change in the Oro-facial Appearance dimension score, adjusted for treated jaw (maxilla/mandible) and the number of missing teeth. To better understand the characteristics of OHRQoL, each dimension score was converted to a percentage because the number of items for each dimension was different.

All statistical analyses were performed using SPSS version 22 (SPSS Inc., Chicago, IL, USA), and the level of significance was set at 0.05.

**RESULTS**

**Baseline OHIP scores**

The mean OHIP summary score of all patients were 46.8 ± 24.5 at baseline. The mean OHIP summary
score for the anterior group (50.9 ± 24.1) tended to be higher than that for the posterior group (44.4 ± 35.8); however, this difference was not statistically significant (P = .25; ES = .27) (Table 2).

Regarding dimension scores, the mean Oro-facial Appearance score for the anterior group (10.4 ± 5.1) was significantly higher than that of the posterior group (7.2 ± 3.8) (P < .01; ES = .63) (Table 2).

When the 4 dimension scores were standardized in percentage to their corresponding full score, the impairment of Oro-facial Appearance was the highest in both groups (Fig. 1).

Follow-up OHIP scores
The mean OHIP summary and 4 dimension scores decreased significantly with high ES after the implant treatment (P < .001; ES = .92) (Table 2).

When the subjects were divided into 2 groups, the same trend was also found for both groups (P < .05) (Table 2) and significant group differences were not found in any post-treatment scores (Table 2).

Changes in OHIP scores after treatment
The magnitude of change in the OHIP summary score (ΔT = follow-up scores − baseline scores) for the anterior group tended to be larger than that for the posterior group; however, this difference was not statistically significant (Table 2).

The magnitude of percentage change in the 4 dimension scores for the anterior group was the highest for Oro-facial Appearance, followed by Oral Function, Psychosocial Impact, and Oro-facial Pain, while that for the posterior group was the highest for Psychosocial Impact, followed by Oral Function, Oro-facial Appearance, and Oro-facial Pain (Fig. 1).

The regression analysis revealed a significant association between the location of the most anteriorly placed implant and change in the Oro-facial Appearance score (adjusted R² = .073; P = .015). The regression coefficient remained unchanged when the number of missing teeth and treated jaw (maxilla or mandible) were included in the statistical model, indicating very little potential confounding by these factors (Table 3).

DISCUSSION
The focus of the present study was to explore the possible association between the location of the implant treatment and its outcome as evaluated by OHRQoL. We included patients with a limited number of missing teeth exclusively, because they are the most typical individuals who seek dental implant treatment. The effects of implant treatment were evaluated multi-dimensionally using OHIP dimension scores in patients with a limited number of missing teeth. Overall, this study demonstrated
that these patients generally experienced impairment of OHRQoL at baseline, and its profile differed depending on the region of the missing tooth/teeth. More specifically, the anterior group was associated with a significantly higher level of impairment of *Oro-facial Appearance* dimension of the OHRQoL. The study also demonstrated that both anterior and posterior implant treatment improved every dimension of OHRQoL, but a higher degree of the improvement in *Oro-facial Appearance* was found for the anterior group. Based on these findings, therefore, we can reject our null hypothesis (i.e., that there is no difference in changes in magnitude and nature of OHRQoL between patients who received anterior and posterior implants).

The higher impairment of *Oro-facial Appearance* dimension in the anterior group compared with the posterior group at baseline was reasonably predictable and consistent with previously reported anecdotal experiences of clinicians. They are also consistent with the dimensional model of OHRQoL, which suggests that individuals perceive the impact of oral disorders in 4 dimensions, which were defined as *Oral Function*, *Oro-facial Pain*, *Oro-facial Appearance* and *Psychosocial Impact* and constructed based on the results from the Dimensions of Oral Health-Related Quality of Life Project. In other words, our results suggest that the structure of OHRQoL would be better understood by this dimension model. While the traditional 7-dimensional structure may be useful for this purpose, it should be noted that it is not supported by empirical evidence.

Although the OHIP scores for the posterior group were generally lower compared with those for the anterior group, these differences were not statistically significant. It should be noted that the posterior group in the present study had at least four premolar and one molar contacts (6 occlusal units [OUs]; one unit corresponds to a pair of occluding premolars, whereas a pair of occluding molars correspond to two units). These patients are categorized into sub-groups of shortened dental arch (SDA), and the degree of OHRQoL impairments in SDA patients, who retain 6 OUs, has been reported to be small. This may be a possible explanation for why the baseline OHRQoL impairment in the posterior group tended to be lower than that of the anterior group. However, it should also be noted that subjects in the current study were different from the typical SDA patient population because they actually sought implant treatments, probably due to perception of OHRQoL impairment, which may have been the motivation for seeking implant treatment, as suggested by Slade and Spencer.

Regarding the OHRQoL profile of the posterior group, we initially speculated that these patients would generally experience more impairment of function, such as masticatory disturbance due to loss of occlusal support, than the anterior group. However, statistically significant differences were not
recognized in the functional dimension values at baseline nor in the magnitude of the improvement after the treatment between the anterior and posterior groups. Based on the original concept of the SDA by Käyser et al., subjective patient’s masticatory ability and oral health status are reported not to be decreased in patients who exhibited intact anterior dentition up to the second premolars. Furthermore, the Oral Function dimension included items related to pronunciation and speech, which would be impaired by losses of the anterior teeth. In fact, Levi et al. demonstrated anterior implants affected not only esthetics but also function.

After treatment, all of the OHIP summary and dimension scores for both groups significantly decreased and recovered to levels comparable with healthy and dentulous patients. As a result, a marked improvement in the Oro-facial Appearance dimension was observed for the anterior groups, which is consistent with the results of a study that reported a high level of patient satisfaction with a single implant placement in the esthetic region, and also partially and indirectly support a study reporting a lower level of improvement in OHIP scores by implant placed in the posterior region. We further demonstrated that the more anterior the implants were placed, the more improvement in appearance was achieved, and this association was valid independent of the number of missing teeth and jaw treated.

The major limitation of the present study was the rather small sample size. While more than 60 patients were recruited consecutively in an attempt to generalize our findings to the target population, our sampling method could not ensure sufficient sample size for each region, which in turn did not enable us to conduct further sub-group comparisons and analyses. Although some of our findings indicate clinical relevance, they were not statistically significant; therefore, future studies should be conducted with a larger sample size. Furthermore, our study subjects may not have represented the patient population in general practice because they were recruited at university-based prosthodontic clinics. Next, socio-economic information, which is regarded to be a confounding factor in patients’ perception of OHRQoL, was not gathered in this study. Finally, OHRQoL data were collected one month after treatment. Although a one-month recall period has been suggested to be reasonable to capture patients’ perception of their OHRQoL, a longer follow-up is recommended in future studies.

Nevertheless, the present study was the first to examine the effect of implant treatment location on magnitude and nature of OHRQoL in a systematic manner, and should be regarded as exploratory rather than confirmative. Confirmative studies with adequate statistical power, involving population-based patients and longer follow-up periods, are warranted given that exploratory studies, such as ours,
have found clinically relevant associations.

CONCLUSION
Within the limitations of this study, the results suggest that the location of dental implant treatment influences OHRQoL impairment and improvement after treatment. Quantitative understanding of prosthodontic treatment outcome, as evaluated by OHRQoL, is of clinical importance because this information has a direct influence on clinical decision-making in daily dental practice, and enables clinicians to provide patients with information regarding clinical endpoints in terms of improvement(s) in OHRQoL.

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REFERENCES


**Figure & Legend**

**Fig. 1** The percentage of 4 dimension scores at baseline and follow-up.