Single-Tooth Implant Versus Three-Unit Fixed Partial Denture: A Study of Oral Health–Related Quality of Life

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Purpose: *Many studies have investigated the impact of prosthetic treatment on oral health–related quality of life (OHRQoL). However, most of these have been performed among fully or partially edentulous patients. Studies involving patients with a single missing tooth are limited. The purpose of this study was to compare the OHRQoL between patients treated by single-tooth implants and three-unit fixed partial dentures (FPDs) for single missing tooth restoration.* ***Materials and Methods:*** *A cross-sectional survey was conducted in Korea with patients drawn by stratified purposive sampling based on age. OHRQoL was measured using the Korean version of the 14-item Oral Health Impact Profile (OHIP-14K) questionnaire. Pre- and posttreatment OHIP-14K scores were compared by paired t test. Single-tooth implants and three-unit FPDs were compared by two-sample t test. In addition, multiple regression analysis was used to evaluate the impact of treatment mode on OHIP-14K total score after adjusting the effect of demographics and clinical factors.* ***Results:*** *Thirty-five patients with single-tooth implants and 36 patients with three-unit FPDs were included. All participants had a significant improvement in OHRQoL compared with before the treatment ($P < .0001$). However, there was no statistically significant difference in the change of OHIP-14K score between the two treatment modes. In addition, the treatment mode had no significant impact on the change of OHIP-14K total score after adjusting the influence of covariates ($P = .170$).* ***Conclusion:*** *Both single-tooth implants and three-unit FPDs for single missing tooth replacement resulted in significant and similar improvement of OHRQoL.* Int J Oral Maxillofac Implants 2016;31:376–391. doi: 10.11607/jomi.4191

Keywords: *OHIP-14, oral health impact profile, oral health–related quality of life, single missing tooth, single-tooth implant, three-unit fixed partial denture*

Tooth loss, a typical consequence of dental caries and periodontal disease, is one of the most common oral health problems in adults.[1] Tooth loss can worsen general health and quality of life, including the inability to chew, poor speech, pain, and dissatisfaction with appearance.[2,3] Therefore, the demand for prosthetic treatment as tooth replacement is rapidly increasing.[4] The Korea National Health and Nutrition Examination Survey from 2007 to 2009 reported that 27.2% of the Korean population had received a prosthetic treatment at least once, and 12.9% were in need of further prosthetic treatment. As the demand for prosthetic treatment increases with age, in the age group of 40 to 69 years, 46.9% had received a prosthetic treatment and 20.2% wanted to receive a prosthetic treatment.[5]

When evaluating and comparing different prosthetic treatment options, factors such as treatment cost, survival rate of the prostheses, esthetics, and frequency of complications are considered. In recent years, measurement of the oral health–related quality of life (OHRQoL) has become increasingly important, as patient-reported outcomes are essential when evaluating treatments in health care.[6] The Oral Health Impact Profile (OHIP) developed by Slade and Spencer in 1994 has been widely used to measure the impact of oral disorders on OHRQoL.[7] This instrument, based on Locker's conceptual framework for oral health,

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Table 1 Characteristics of the Study Sample

Variables	Single-tooth implant (n = 35)	Three-unit FPD (n = 36)	Total (n = 71)	*P**
Age,mean ± SD	52.7 ± 8.1	51.7 ± 8.7	52.2 ± 8.3	.600
Sex, n (%)				
Male	8 (22.9%)	14 (38.9%)	22 (31.0%)	.144
Female	27 (77.1%)	22 (61.1%)	49 (69.0%)	
Average monthly household income, n (%)				
< 3,000,000 KRW	6 (17.1%)	11 (30.6%)	17 (23.9%)	
3,000,000–5,000,000 KRW	15 (42.9%)	12 (33.3%)	27 (38.0%)	.401
≥ 5,000,000 KRW	14 (40.0%)	13 (36.1%)	27 (38.0%)	
Education level, n (%)				
High school graduate or under	22 (62.9%)	21 (58.3%)	43 (60.6%)	.697
University attending or over	13 (37.1%)	15 (41.7%)	28 (39.4%)	
Smoking frequency, n (%)				
Not at all	32 (91.4%)	29 (80.6%)	61 (85.9%)	
Occasionally	0 (0.0%)	4 (11.1%)	4 (5.6%)	.154
Daily	3 (8.6%)	3 (8.3%)	6 (8.5%)	
Frequency of dental check-ups, n (%)				
Not at all or uncomfortable only	7 (20.0%)	13 (36.1%)	20 (28.2%)	.131
Regular visits	28 (80.0%)	23 (63.9%)	51 (71.8%)	
Self-perceived general health status, n (%)				
Very good/good/moderate	34 (97.1%)	33 (91.7%)	67 (94.4%)	.318
Poor/very poor	1 (2.9%)	3 (8.3%)	4 (5.6%)	
Self-perceived oral health status, n (%)				
Very good/good/moderate	31 (88.6%)	29 (80.6%)	60 (84.5%)	.351
Poor/very poor	4 (11.4%)	7 (19.4%)	11 (15.5%)	
Oral disease, n (%)				
No	30 (85.7%)	24 (66.7%)	54 (76.1%)	.060
Yes (dental caries, periodontal disease, etc)	5 (14.3%)	12 (33.3%)	17 (23.9%)	
Number of treated teeth, mean ± SD	1.5 ± 0.5	1.3 ± 0.6	1.4 ± 0.5	.072
Period after treatment (y), mean ± SD	2.1 ± 1.7	2.6 ± 3.3	2.4 ± 2.7	.756

FPD = fixed partial denture; KRW = Korean currency won in the year 2011 value.
*Wilcoxon rank-sum test for continuous variables; chi-square test or Fisher's exact test for categorical variables.

measures the impact of oral problems on physical, social, and psychologic well-being.[8] However, the original OHIP-49 is not practical in a clinical setting because of many questions.[9] Hence, OHIP-14 (a shorter version of OHIP-49) has been commonly used. OHIP-14 has been proven to be a valid and reliable tool in OHRQoL research.[10–13]

Thus far, many studies have been conducted to evaluate the impact of prosthetic treatment on OHRQoL. However, most of these studies have been performed among fully or partially edentulous patients.[2,14–20] Studies involving patients with a single missing tooth are limited. Therefore, the aim of this study was to compare OHIP-14–measured OHRQoL between single-tooth implants and three-unit fixed partial dentures (FPDs) for single missing tooth restoration.

MATERIALS AND METHODS

Subjects and Study Design

Patients who received single-tooth implants and three-unit FPDs as single missing tooth restoration in dental clinics in Korea were recruited for a cross-sectional survey. The subjects were selected by a stratified purposive sampling approach based on age (40 to 69 years). Each interviewer recruited participants by identifying potential respondents through a screening questionnaire. To take part in this survey, the following inclusion criteria were used: *(1)* age of 40 to 69 years; *(2)* patients with a single missing tooth (those who received treatment for missing teeth not located directly adjacent to each other were included, while those who received treatment for adjacent teeth were excluded); *(3)* patients who had received single-tooth implants or three-unit

Table 2 OHIP-14K Scores in Single-Tooth Implant and Three-Unit FPD Groups

	Single-tooth implant, mean ± SD (n = 35)				Three-unit FPD, mean ± SD (n = 36)	
OHIP-14K[a]	Before	After	Change	*P*[d]	Before	After
Total OHIP-14K score[b]	25.46 ± 9.75	8.09 ± 5.72	17.37 ± 9.63	< .0001	28.44 ± 8.78	10.36 ± 6.19
OHIP-14K dimensions[c]						
Functional limitation	3.43 ± 1.48	1.17 ± 0.98	2.26 ± 1.44	< .0001	3.89 ± 1.69	1.64 ± 1.05
Physical pain	4.11 ± 1.64	1.37 ± 1.09	2.74 ± 1.80	< .0001	4.52 ± 1.56	1.92 ± 1.32
Psychologic discomfort	3.71 ± 1.53	1.14 ± 0.91	2.57 ± 1.72	< .0001	4.36 ± 1.40	1.31 ± 0.82
Physical disability	4.26 ± 1.75	1.26 ± 1.01	3.00 ± 1.77	< .0001	4.64 ± 1.71	1.83 ± 1.21
Psychologic disability	3.49 ± 1.79	1.03 ± 0.98	2.46 ± 1.90	< .0001	3.81 ± 1.53	1.17 ± 1.00
Social disability	3.03 ± 1.67	1.06 ± 0.97	1.97 ± 1.74	< .0001	3.42 ± 1.75	1.19 ± 1.06
Handicap	3.43 ± 1.80	1.06 ± 0.91	2.37 ± 1.82	< .0001	3.81 ± 1.51	1.31 ± 0.95

OHIP = Oral Health Impact Profile; FPD = fixed partial denture.
[a]Responses were rated on a scale of 0 to 4 (never = 0, hardly ever = 1, occasionally = 2, fairly often = 3, or very often = 4). Higher OHIP scores indicate worse OHRQoL.
[b]Total OHIP-14K score is calculated by summing up the coded responses from all questions (ranging from 0 = never having experienced any of the oral health problems to 56 = very often experienced all the oral health problems).
[c]The 14 items of OHIP-14K are grouped into seven dimensions containing two questions: functional limitation (trouble pronouncing words and worsened sense of taste), physical pain (painful aching in mouth and discomfort eating foods), psychologic discomfort (feeling self-conscious and feeling tense), physical disability (unsatisfactory diet and interrupted meals), psychologic disability (difficulty relaxing and embarrassment), social disability (irritable with other people and difficulty in doing usual jobs), and handicap (life less satisfying and inability to function).
[d]By paired *t* test between before and after the treatment.
[e]By two-sample *t* test between single-tooth implant and three-unit FPD.

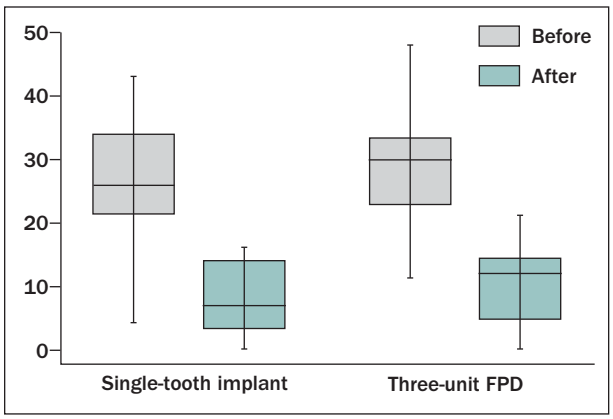

Fig 1 Total OHIP-14K scores before and after the treatment for single-tooth implants and three-unit FPDs. *There was a significant difference between before and after the treatment for total OHIP-14K score ($P < .0001$).

FPDs; *(4)* adequate cognitive ability to understand and answer the questions; and *(5)* voluntary agreement to participate in this survey.

Each subject was interviewed face-to-face by a well-trained interviewer from September to October 2011. Interviewers were extensively trained using an instruction sheet on the picture of each prosthetic treatment, the questionnaire content, and the survey method to reduce interview bias and to select appropriate subjects. Subjects completed the questionnaire under the instruction of the well-trained interviewers. Interviewers provided detailed information about the pre- and posttreatment scenarios to increase the respondents' level of understanding.

This study was approved by the Institutional Review Board of the National Evidence-based Healthcare Collaborating Agency (NECA). Informed consent was obtained from all patients before the study.

Questionnaire

A questionnaire was constructed based on the literature review and expert opinion. This questionnaire was modified according to the results of a pilot test among 10 patients with prosthetic treatment experience and in-depth interviews with 5 patients receiving prosthetic treatment. The questionnaire included questions related to sociodemographics, self-reported health status, clinical condition, and measurement of OHRQoL.

OHRQoL was measured using the Korean version of OHIP-14 (OHIP-14K). OHIP-14K has been proven to be a reliable and valid tool for assessing OHRQoL.[11–13] This questionnaire asked how frequently subjects had experienced oral problems in the 12 months preceding treatment and after treatment. OHIP-14K includes 14 items grouped into seven domains containing two questions: functional limitation (trouble pronouncing words and worsened sense of taste), physical pain (painful aching in the mouth and discomfort eating foods), psychologic discomfort (feeling self-conscious and feeling tense), physical disability (unsatisfactory diet and interrupted meals), psychologic disability (difficulty relaxing and embarrassment), social disability (irritable with other people and difficulty in doing usual jobs), and handicap (life less satisfying and inability to function). Responses for each item were coded as never (0), hardly ever (1), occasionally (2), fairly often (3), or very often (4). The

	Three-unit FPD, mean ± SD (n = 36)		Single-tooth implant vs FPD
	Change	P[d]	P[e]
	18.08 ± 9.87	< .0001	.759
	2.25 ± 1.70	< .0001	.985
	2.61 ± 1.82	< .0001	.761
	3.06 ± 1.71	< .0001	.238
	2.81 ± 1.94	< .0001	.660
	2.64 ± 1.76	< .0001	.677
	2.22 ± 1.82	< .0001	.555
	2.50 ± 1.66	< .0001	.757

total score was obtained by summing up the coded responses from all questions, and ranged from 0 (never having experienced any of the oral health problems) to 56 (very often experienced all the oral health problems). Higher OHIP scores indicated greater damage of OHRQoL caused by oral diseases. In other words, higher OHIP scores represented worse OHRQoL.

Statistical Analyses

Descriptive statistics analysis was performed to assess sociodemographics, self-reported health status, and oral health information. The comparison between single-tooth implants and three-unit FPDs for categorical variables was performed using the chi-square test or Fisher's exact test. Because the statistics for continuous variables were not normally distributed based on the Shapiro-Wilk test, the Wilcoxon rank sum test was conducted.

OHIP-14K scores were calculated by adding together the ordinal values for each dimension and the OHIP total. The comparison of OHIP-14K scores between before and after the treatment was performed by paired *t* test for each treatment mode. The difference between single-tooth implants and three-unit FPDs (based on the change score of OHIP-14K between before and after the treatment) was tested by the two-sample *t* test. The change in OHIP-14K score was calculated by subtracting the posttreatment score from the pretreatment score.

In addition, multiple regression analysis was performed to evaluate the impact of treatment mode on change of the OHIP-14K total score after adjusting the effect of demographics and clinical factors. The change in the OHIP-14K total score was used as the dependent variable, and the treatment mode was used as the independent variable with covariates of age, sex, self-perceived oral health status, and pretreatment OHIP-14K score (OHIP-14K score before prosthetic treatment). Age and sex were included in covariates because differences between sex and age groups were found in measuring the OHIP scores as well as the most commonly available demographic information.[20–22] Self-perceived oral health status and baseline OHRQoL were considered as clinical factors since they could influence the change of OHIP-14K scores. The statistical analyses were performed using Stata SE 12.0 (Stata), and the level of significance was set at $\alpha = .05$.

RESULTS

Table 1 presents the characteristics of the study sample. A total of 71 subjects responded to the survey. There were 35 patients in the single-tooth implant group and 36 patients in the three-unit FPD group. The sociodemographics and clinical characteristics of the two groups were similar. The mean age was 52.2 years, and 69.0% of all subjects were women. In addition, 23.9% had oral disease, such as dental caries and periodontal disease.

A significant reduction in the total and all subscale scores of OHIP-14K was found after the treatment for both single-tooth implant and three-unit FPD patients ($P < .0001$; Table 2). Patients with a single-tooth implant showed the highest improvement in physical disability (change score = 3.00, $P < .0001$) and the lowest change in social disability (change score = 1.97, $P < .0001$) compared with pretreatment. Patients with three-unit FPDs showed the highest improvement in psychologic discomfort (change score = 3.06, $P < .0001$) and the lowest change in social disability (change score = 2.22, $P < .0001$) compared with pretreatment. For the single-tooth implants, the mean OHIP-14K total score was 25.46 and 8.09 before and after the treatment, respectively. As a result, there was a significant reduction in OHIP-14K total score of 17.37 after single-tooth implant treatment ($P < .0001$). For the three-unit FPDs, the mean OHIP-14K total score changed from 28.44 to 10.36, leading to a significant reduction of 18.08 ($P < .0001$). In other words, both single-tooth implants and three-unit FPDs significantly improved the OHRQoL compared with pretreatment (Fig 1).

However, the differences between the two treatment modes (single-tooth implant vs three-unit FPD) were not statistically significant in total and all subscale scores of OHIP-14K (Table 2). In addition, the impact of the treatment mode on the change of OHIP-14K total score after adjusting for age, sex, self-reported oral health status, and pretreatment OHIP score was not statistically significant ($P = .170$; Table 3).

Table 3 Multiple Regression Analysis of the Change in OHIP-14K Total Score (N = 71)

Variables	Coefficient (95% CI)	*P*
Prosthetic treatment type		
Three-unit FPD	Reference	
Single-tooth implant	2.013 (–0.882 to 4.908)	.170
Age	–0.075 (–0.247 to 0.098)	.392
Sex		
Male	Reference	
Female	–1.155 (–4.256 to 1.946)	.460
Self-perceived oral health status		
Poor/very poor	Reference	
Very good/good/moderate	1.146 (–2.833 to 5.126)	.567
OHIP-14K score before prosthetic treatment	0.855 (0.700 to 1.011)	.000
Constant	–2.610 (–14.210 to 8.990)	.655

CI = confidence interval; OHIP = Oral Health Impact Profile; FPD = fixed partial denture.
$R2 = 0.657$; adjusted $R2 = 0.630$; $F = 24.85$; $P < .0001$

DISCUSSION

This study assessed the impact of single missing tooth restoration by single-tooth implants and three-unit FPDs on OHRQoL. Both single-tooth implants and three-unit FPDs provided a significant improvement in OHRQoL (< .0001). Prior to the prosthetic treatment, mean OHIP-14K scores for each dimension were three points or more. After treatment, OHIP-14K scores decreased by about one point for all dimensions, indicating an improvement in OHRQoL. In previous studies assessing the impact of a single intervention on OHRQoL using OHIP, similar to the findings of this study, each single-tooth implant and resin-bonded FPD significantly improved the OHRQoL.[23,24]

The magnitude of improvement in OHRQoL as measured by the OHIP-14K total score was 17.37 (SD = 9.63) and 18.08 (SD = 9.87) for single-tooth implants and three-unit FPDs, respectively. Although the change of OHIP-14K total score in three-unit FPDs might be slightly larger than that in single-tooth implants because of the higher pretreatment OHIP-14K score, the difference between the two treatments was not statistically significant ($P = .759$). In addition, there were no statistically significant differences between the two treatments in the change of score for each dimension of OHIP-14K. The impact of the treatment mode (single-tooth implant vs three-unit FPD) on the change of OHIP-14 total score after adjusting for the effect of other factors was not statistically significant. This is in agreement with a previous study involving patients with implant-supported crowns or two-unit cantilevered resin-bonded FPDs as a single missing tooth restoration.[25] In that study, Lam et al found no significant differences between the two treatment modes.[25] However, the authors studied two-unit cantilevered resin-bonded FPDs, which is a different technique from the conventional FPD used in this study. To the authors' knowledge, this study is the first attempt to compare OHRQoL using OHIP-14 between single-tooth implants and conventional three-unit FPDs, which are widely used for the replacement of a single missing tooth.

Dental implants offer significant advantages in terms of improved esthetics and functional results, and they preserve integrity of the existing teeth.[26] However, there are disadvantages, including the burdens of surgery, long treatment period, and high treatment costs. On the other hand, FPDs are useful if patients have systemic health problems that make them ineligible for surgery. In addition, FPDs are much cheaper than dental implant therapy. One major disadvantage of FPDs is that FPDs use the two teeth next to the missing tooth as abutments, thus possibly causing damage to the neighboring teeth.[26] Therefore, it is necessary to take into account various factors as well as the impact on OHRQoL when making a treatment decision to replace a single missing tooth.[26,27]

A limitation of this study is the small sample size. Therefore, these data should be interpreted carefully. However, in the study of Lam et al, which targeted subjects similar to this study, a sample size of 64 patients was required to detect the moderate effect size of 0.5 with 80% power and at the .05 significance level.[25,28] Also, in this study, to ensure sample homogeneity, patients with a single missing tooth and target interventions were defined by several discussions with the clinical experts. Interviewers were extensively trained using an instruction sheet on the picture of each prosthetic treatment to select appropriate subjects. As a result, despite its small size, the sample reflected well the characteristics of patients receiving single-tooth implants and three-unit FPDs for

treatment of a single missing tooth. Another limitation of this study was its cross-sectional design. Because this study investigated patients who had already received the prosthetic treatment, pretreatment and posttreatment OHIP-14K scores were measured simultaneously after the prosthetic treatment. As a result, the assessment for the pretreatment may be inaccurate for reasons such as recall bias. Therefore, the results of this study should be interpreted with caution. However, because the condition before the treatment can affect the treatment outcomes,[19] comparison for the differences between before and after the treatment is more appropriate when comparing the treatment modes. Therefore, although this cross-sectional study cannot provide a precise estimation for the pretreatment OHIP-14K score, the impact of treatment mode was compared using the change of OHIP-14K score between pretreatment and posttreatment. In addition, to control the effect of the pretreatment OHIP-14K score, the impact of treatment mode on the change of OHIP-14K score was evaluated using multiple regression analysis with the pretreatment OHIP-14K score as a covariate. The results confirmed that the difference between single-tooth implant and three-unit FPD users was not statistically significant, which is consistent with the results of this study.

CONCLUSIONS

Both single-tooth implants and three-unit FPDs as single missing tooth replacement resulted in significant and similar improvement in OHRQoL, but uncertainty exists due to small sample size and recall bias. Therefore, prospective studies with larger samples are required to confirm these results.

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