Association Between Factors Related to the Time of Wearing Complete Dentures and Oral Health–Related Quality of Life in Patients Who Maintained a Recall

Mike T. John, DDS, PhD, MPH, PhD[a]/András Szentpétery, DDS, PhD[b]/James G. Steele, BDS, FDS, PhD[c]

Purpose: To investigate the association between factors related to the time of wearing complete dentures (CDs) and oral health–related quality of life (OHRQoL) in edentulous patients who maintained a recall. ***Materials and Methods:*** OHRQoL was measured using the German version of the Oral Health Impact Profile (OHIP-G) in a convenience sample of 50 edentulous prosthodontic patients (mean age ± SD: 72.5 ± 9.4; age range: 52 to 91 years, 66% women) maintaining a recall 2 to 51 months after CD treatment. The outcome of the study was the sum of OHIP-G item responses (OHIP-G49; range, 0 to 196) that characterized OHRQoL. Exposure variables were *(1)* time since first treatment with CDs, *(2)* number of previous CDs, *(3)* age of present CDs, and *(4)* age at which first CDs were provided. The association between exposure variables and outcome was investigated using an ordinary least-square regression analysis, controlling for the effects of age. ***Results:*** Age of current CDs, time since first CD, number of previous CDs, and the age at which CDs were first provided did not significantly influence OHRQoL. Regression coefficients for each exposure variable were, respectively, 0.0, 95% CI: –0.1 to 0.2; –0.1, 95% CI: –0.4 to 0.3; 0.8, 95% CI: –1.5 to 3.0, and 0.4, 95% CI: –0.1 to 0.8. ***Conclusion:*** The response to inevitable anatomic and biologic changes in the oral cavity related to edentulism, denture-wearing, age, and other factors does not necessarily translate rapidly into changes in perceived oral health in patients wearing CDs and maintaining a recall. *Int J Prosthodont 2007;20:31–36.*

Complete denture (CD) wearers are substantially impaired in their oral health–related quality of life (OHRQoL) and suffer from more problems in the orofacial area than subjects with removable partial dentures.[1] There is also a strong relationship between the number of natural teeth and OHRQoL[2]; edentulous people present with more oral health problems compared with subjects from a clinical population presenting for new fixed prostheses.[3] However, there is little evidence to indicate which factors may influence OHRQoL after the last teeth have been removed and CDs have been provided. Direct biologic changes related to wearing complete dentures (eg, alveolar ridge resorption and mucosal reactions) and indirect functional effects (eg, changes in masticatory function and taste perception) have been described in subjects wearing CDs,[4] but the extent to which these affect OHRQoL is not known, though they are likely to be important. It would seem reasonable to hypothesize that these changes, assumed to be related to the length of time that a person has worn CDs, might adversely effect OHRQoL in the long term. Results of studies in which some aspects of OHRQoL with instruments targeting general quality of life[5] or satisfaction with the dentures,[6] for example, were investigated may provide some insight into which factors related to the time of wearing CDs influence OHRQoL. Age of the CDs,[7] duration of edentulism, and wearing CDs for the first time[8] affected perceived oral health. Age-related processes in the oral cavity may confound these associations, whereas the process of physiologic and psychologic adjustment may modify them.

[a]*Associate Professor, Department of Prosthodontics and Materials Science, University of Leipzig, Germany.*
[b]*Associate Professor, Department of Prosthodontics, Martin-Luther-University Halle-Wittenberg, Halle/Saale, Germany.*
[c]*Professor of Oral Health Services Research, Department of Restorative Dentistry, School of Dental Sciences, University of Newcastle upon Tyne, United Kingdom.*

Correspondence to: *Mike T. John, Department of Prosthodontics and Materials Science, University of Leipzig, Nürnberger Str. 57, 04103 Leipzig, Germany. Fax: +49-341-9721-329. E-mail: mike.john@medizin.uni-leipzig.de*

The aim of this study was to investigate whether there was any obvious association between time-related variables (time since first treatment with CDs, number of previous CDs, age of the present CDs, age at which first CDs were provided) and OHRQoL in edentulous patients who attended recall appointments over a period of time.

Materials and Methods

Subjects, Study Design, and Setting

The subjects for this clinical cross-sectional study were a convenience sample of edentulous patients treated with CDs in the Department of Prosthodontics, Martin Luther University Halle-Wittenberg. Patients were treated by staff members of the department and by dental students supervised by faculty staff. After insertion of CDs, the patients were advised to return at least once per year. A letter was sent to 161 patients who had been reviewed following provision of CDs within the previous 52 months, inviting them to participate in a follow-up study. Twenty patients were excluded, as they had moved out of town, died, or were too sick to attend the follow-up. Ten patients actively refused to take part, and 81 did not attend the appointment despite 2 attempts to invite them. This left 50 patients who participated in the study. The proportion of subjects responding was 35% (50/[161 – 20]). Informed consent was obtained from the participants. The institutional review board of Martin Luther University approved the study.

The final group of subjects completed the German version[9] of the English-language Oral Health Impact Profile,[10] (OHIP-G), a questionnaire that measures OHRQoL. For each OHIP question, subjects were asked how frequently they had experienced the impact in the last month. Responses were made on a scale of 0 to 4 (0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, 4 = very often). OHRQoL impairment was characterized by the OHIP-G summary score (OHIP-G49), which is the sum of all 49 item frequencies contained in the English-language OHIP (the 4 German-specific items were omitted to maintain international comparability). Internal consistency was investigated and was considered sufficient with a Cronbach alpha of .89.

OHIP-G49 scores were also compared with those of a previous case series of prosthodontic patients to allow comparison with a pretreatment group of patients presenting for CDs[11] and with CD-wearing subjects from the general population.[1]

The influence of the following 4 exposure variables on OHRQoL was investigated:

1. Age of present CDs ("When did you get the complete dentures you are presently wearing?")
2. Number of previous CDs ("How many previous complete dentures did you wear?")
3. Time since first CDs ("When did you get your first complete dentures?")
4. Age at which first CDs were provided.

CDs were defined in this study as the presence of maxillary and mandibular CDs, ie, the subject was edentulous and wore both CDs. Therefore, the 4 variables related to the time of wearing dentures refer to a full set of CDs.

Statistical Analyses

To provide a visual impression about the (possibly nonlinear) associations between the exposure variables and the outcome, *locally weighted scatterplot smoothing* (LOWESS) was used. LOWESS combines much of the simplicity of linear least-squares regression with the flexibility of nonlinear regression. It does this by fitting simple models to localized subsets of the data, so at each point in the data set, a low-degree polynomial is fit to a subset of the data. The procedure displays a trend of the outcome variable (ie, OHRQoL) as a function of the exposure variable (ie, 1 of the 4 time-of-denture-wearing–related variables or age).

In a second step, regression analyses (ordinary least-squares [OLS]) were used to investigate the linear association between each of the exposure variables (or age) and the outcome. Finally, age was included in each of the other regression analyses, relating each exposure variable to the outcome. This allowed the influence of the exposures to be investigated with age controlled as a variable. Regression diagnostics investigated the assumptions of OLS regression, in particular the assumption of variance homogeneity and the normal distribution of errors of the statistical model. Based on plots of the exposure variables against the outcome "influential observations," single observations that departed considerably from the bulk of the data were identified and excluded from the analyses.

All analyses were performed using the statistical software package STATA (Stata Statistical Software, Release 8, StataCorp LP), with the probability of a type 1 error set at the .05 level.

Results

Of the 50 subjects (median age = 74; interquartile range = 14 years; range = 52 to 91 years), 66% were women. Study participants' OHIP scores ranged between 0 and 54 points; the median score was 13.5. For 6 subjects (12%) the current CD treatment was their first. Sixteen subjects (32%) had 1 previous CD, 14 (28%) had 2 previous CDs, and 14 (28%) had between 3 and 9 previous

Table 1 Gender, Age, and Variables Characterizing Time of Wearing CD in 2 Groups of Subjects with OHRQoL Below or Above the Sample's OHIP-G Summary Score Median

Variable	Lower impaired OHRQoL (0–13.5 OHIP-G points)*	Higher impaired OHRQoL (14–54 OHIP-G points)*
Gender (f)	56 (14)	76 (19)
Age (y)	74 (14)	74 (13)
Age of current CDs (mo)	24 (24)	36 (36)
Time since first CDs (mo)	16 (22)	13 (19)
No. of previous CDs	2 (1)	2 (2)
Age at which first CDs were provided (y)	74 (12)	73 (14)

*Figures are presented as % (no. of subjects) or median (interquartile range).

CDs. Typically, subjects had been last treated 24 months (median) ago and they were, on average, 73 years old when CDs were first provided. The median age of their current denture was 14.5 months, and 50% of the subjects had dentures between 6 and 26 months old.

Table 1 shows the distributions of gender, age, and variables characterizing the lifetime experience of CD wearing in groups of subjects below and above the median OHIP-G summary score. Subjects reporting more impaired OHRQoL (above the OHIP-G49 median vs below the median) were more often women, had worn their current CDs longer, and had received their first CDs a shorter time before. No (or negligible) differences were observed for age, number of previous CDs, or the age at which patients had received their first CDs.

Additional data sets were available to allow comparison of this group with pretreatment patients and subjects wearing CDs in the general population, and these data are presented in Fig 1, along with the data for the study group. When compared to the recall group in this study, subjects in the general population and subjects demanding treatment with CDs had higher OHIP-G49 medians (23 points/n = 96 and 29 points/n = 34, respectively). The level of study subjects with impaired OHRQoL was very similar to the data for the 1-month follow-up appointment of the pretreatment group (OHIP-G49 score, 13 points/n = 34).

To detect possibly nonlinear associations between age, anamnestic variables relating time of wearing CDs and OHRQoL, scatter plots with a smoothed line were constructed (Figs 2 and 3). No consistent pattern was obvious.

OLS regression analyses supported the visual impressions given by Figs 2 and 3. There were no statistically significant associations between time-related variables and OHRQoL (Table 2) when included alone in the analysis or when controlled for age. Regression coefficients for age of current CDs, time since first CDs, number of previous CDs, and age at which first CDs were provided were small and not considered as clinically important. These coefficients decreased even more toward 0 (no association) when observations with the highest leverage on the regression analysis (see Fig 3;

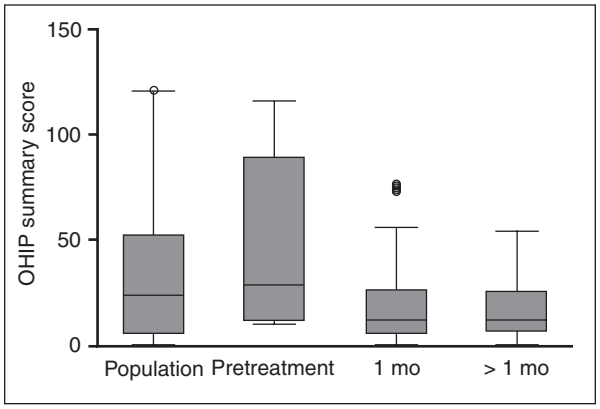


Fig 1 "Longitudinal" course of OHRQoL in subjects with CDs: OHIP-G summary scores of subjects in the general population (population: representing the "normal" level of OHRQoL[1]) are compared with those of the subjects of a case series (pretreatment: level of OHRQoL prompting treatment; 1 mo = OHRQoL level achieved 1 month after treatment was completed[11]) and the level of OHRQoL in the present subjects after a median follow-up of 14.5 months (> 1 mo = present study subjects).

2 subjects with 108 and 120 months since first CD treatment, respectively, or 3 subjects with 7 and 9 previous CDs) were removed from analyses. Regression diagnostics did not reveal substantial deviations from the assumptions of OLS regression analysis.

Discussion

The findings reported here suggest that OHRQoL in edentulous patients does not appear to be substantially affected by either the total time-related burden of CD wearing or the age of the current dentures, at least up to 4 years or so after treatment, if patients attend some recall appointment. The validity of the outcome measure and its ability to measure OHRQoL in CD-wearing patients would seem to be supported by the differences indicated in different sample groups for pretreatment and general population data. All 4 of the measured variables behaved in a similar way in relation to OHIP scores.

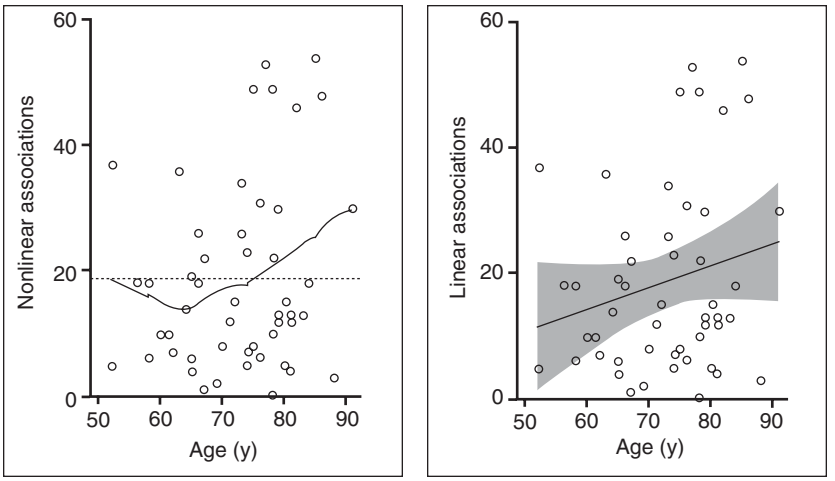
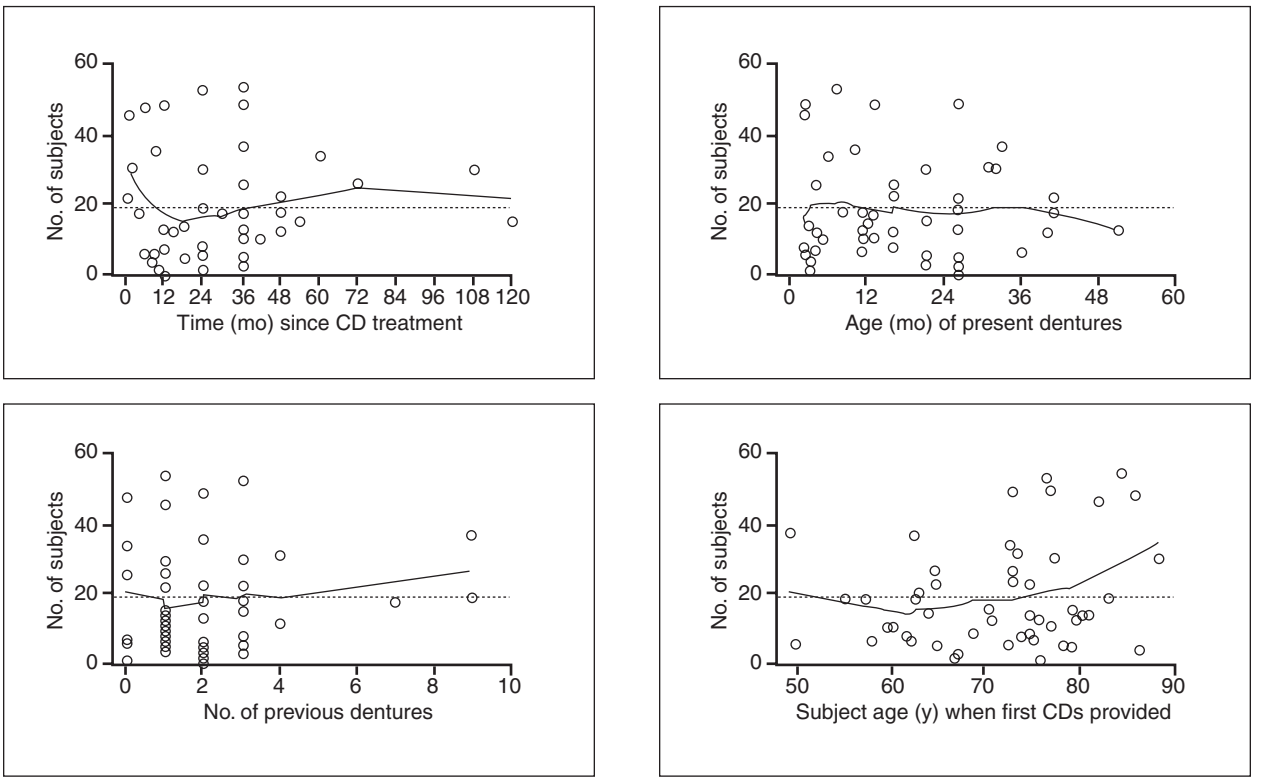


Fig 2 Nonlinear (using LOWESS) and linear assessment with 95% confidence interval (using OLS regression) of the relationship between age and OHRQoL.



Figs 3a to 3d Graphic assessment of the relationships between the 4 exposure variables and the outcome OHRQoL using LOWESS.

Although the sample size in this study was small, the effects for the age-related variables were so marginal that even if a type 2 error (a false negative) were present as a result of the sample size, any statistically significant difference that could be demonstrated with a larger sample would seem unlikely to be clinically relevant. The effects of nonresponse bias are not completely known, although we performed a nonresponse analysis with available data on age, gender, and time of wearing the current CDs. Differences between responders and nonresponders were of small to moderate size and statistically insignificant. In addition, despite the relatively low overall response rate, there is no cohesive argument that would indicate that differences between responders and nonresponders would have made a difference in the relationship between OHIP and denture history. Bias resulting from the low response rate would require the nonresponders to have a considerably different profile for the age-related variables, and there is no good reason why this should be the case, though it is, of course, possible. We did not stratify our analysis according to whether students supervised by staff members or only faculty members treated the patients, because identical standards were

Table 2 Regression Analyses Relating Each of the 4 Exposure Variables to the Outcome of OHIP-G49

	Four regression analyses relating exposure variables to the outcome			Four regression analyses with exposure variables adjusted for age influence		
Variable	Coefficient (95% CI)	*t*	*P*	Coefficient (95% CI)	*t*	*P*
Age of current CDs (mo)	0.0 (–0.1 to 0.2)	0.38	.71	0.0 (–0.2 to 0.2)	0.24	.81
Time since first CDs (mo)	–0.1 (–0.4 to 0.3)	–0.56	.58	–0.1 (–0.5 to 0.2)	–0.73	.47
No. of previous CDs	0.8 (–1.5 to 3.0)	0.67	.51	1.1 (–1.1 to 3.4)	0.99	.33
Age at which first CDs were provided	0.4 (–0.1 to 0.8)	1.62	.11	1.5 (–2.6 to 5.7)	0.73	.47

applied for the quality of the dentures. Finally, it has to be emphasized that our results refer to patients maintaining some recall. How OHRQoL is affected over the time period investigated in this report when edentulous patients do not attend recall appointments may differ from the present findings.

The outcome variable itself, the OHIP, is widely used, and when compared with other similar measures has been shown to give a similar response.[12–16] The reliability of the other variables (those related to denture history) is not known, so some attenuation of the regression coefficients cannot be ruled out.[17]

Before considering the reason for the absence of any relationship it is probably reasonable to identify an a priori hypothesis about the course of OHRQoL in the period following placement of CDs. We might expect a "sinus curve"–like course for OHRQoL over time, ie, the level of perceived oral health problems oscillates over longer time periods. Starting from a "normal" level of impaired OHRQoL in the study population—in this case, CD wearers—problems would be expected to arise with biologic changes (such as loss of alveolar bone), in time prompting patients to seek treatment. OHRQoL should be at its worst, with highest OHIP scores, at this point in its course. The treatment that ensues would be expected to improve OHRQoL, and the summary score for an instrument such as OHIP should fall in response to treatment, as observed by Allen et al.[18] OHRQoL may even improve further after treatment is finished because of the adaptation to the new/modified dentures, as found in a case series.[11] Similar results were seen in patients who were asked about their experiences with palate-covering dentures. Adaptation difficulties had declined considerably 2 months after insertion of dentures, compared to the situation immediately after new dentures were provided.[19] After adaptation is completed, OHRQoL should be at its best. This level of "best" OHRQoL may persist for a while, then, gradually, or perhaps suddenly (for example, trigged by an event), it should move again toward the population average and back to the level at which new treatment is sought, completing the sinus curve. Health professionals may detect oral health problems or prognostic factors that might lead to problems before patients seek treatment. This may prevent worsening of OHRQoL.

At first glance, the results reported here, which show no clear relationships between time-related variables for denture wearing, appear to contradict this hypothesis. It seems likely from these results that OHRQoL stays stable over a longer time scale than the period of about 4 years that is reported here. Literature results support this. Age of the CDs and duration of edentulism were not related to OHRQoL measured by an abbreviated OHIP[20] when these variables were included in a multivariable regression model with sociodemographic factors and coping style characteristics.[21] When OHRQoL was measured by the Geriatric Oral Health Assessment Index,[22] subject age was not related to OHRQoL.[23] In addition, denture satisfaction correlates with OHRQoL,[23] and there are studies on long-term satisfaction that show similar results to those reported here for OHRQoL. In a study by Magnusson, patient satisfaction was still sufficient 5 years after receiving new dentures in the great majority of the CD patients studied.[24] In a study of satisfaction among overdenture wearers, most of the patients were satisfied with the treatment at 5 to 10 years after denture insertion, even though the periodontal assessment was poorer than ideal and a substantial number of abutment teeth had been lost.[25,26] This might suggest that the biologic changes observed following tooth loss and the long-term wearing of CDs[4] are partly offset by an improving ability to cope either physiologically (for example, by learned muscle control) or psychologically over time.

In general, psychologic and interpersonal factors seem to be important determinants of denture satisfaction, and probably OHRQoL, perhaps more so than anatomic or clinical factors.[27] Patient expectations seem to be of particular importance. Subjects who requested implants but received conventional dentures reported little improvement in denture satisfaction and in OHRQoL after treatment, whereas subjects who requested and received implant-retained prostheses reported a significant improvement in satisfaction and OHRQoL, as did subjects

who requested and received conventional dentures.[28] These results are in line with findings that coping style is an important predictor of OHRQoL in CD subjects.[21]

This study covers the period of up to 4 years and a little beyond. Many patients wear their CDs for a good deal longer than this, and it may be that the "sinus curve" relationship, or something like it, between OHRQoL and time applies in populations of denture wearers but over a much longer time scale. Treatment may be sought only after any anatomic and biologic changes outstrip the ability to cope functionally. We would also emphasize that OHRQoL is not equivalent to treatment need, and low summary scores of OHRQoL instruments do not necessarily indicate the absence of a treatment need for other reasons.

Conclusions

The response to inevitable anatomic and biologic changes in oral activity related to edentulism, duration of denture-wearing, age, and other factors does not necessarily translate rapidly into changes in perceived oral health. This may be a result of modification by psychosocial and possibly physiologic influences. The long-term effects, over many years, are not as well known.

Acknowledgments

The authors wish to acknowledge the assistance of Thomas Tamme, DDS (formerly assistant professor at the Department of Prosthodontics, Martin Luther University Halle-Wittenberg), in the data collection and examination of the patients. We are especially grateful to Ms Annett Schrock (University of Leipzig) for her help with data management and analysis.

References

1. John MT, LeResche L, Koepsell TD, Hujoel PP, Miglioretti DL, Micheelis W. Oral health-related quality of life in Germany. Eur J Oral Sci 2003;111:483–491.
2. Steele JG, Sanders AE, Slade GD, et al. How do age and tooth loss affect oral health impacts and quality of life? A study comparing two national samples. Community Dent Oral Epidemiol 2004;32:107–114.
3. Szentpetery AG, John MT, Slade GD, Setz JM. Problems reported by patients before and after prosthodontic treatment. Int J Prosthodont 2005;18:124–131.
4. Carlsson GE. Clinical morbidity and sequelae of treatment with complete dentures. J Prosthet Dent 1998;79:17–23.
5. Yoshida M, Sato Y, Akagawa Y, Hiasa K. Correlation between quality of life and denture satisfaction in elderly complete denture wearers. Int J Prosthodont 2001;14:77–80.
6. Garrett NR, Kapur KK, Perez P. Effects of improvements of poorly fitting dentures and new dentures on patient satisfaction. J Prosthet Dent 1996;76:403–413.
7. Heyink J, Schaub R. Denture problems and the quality of life in a Dutch elderly population. Community Dent Oral Epidemiol 1986;14:193–194.
8. Celebic A, Knezovic-Zlataric D, Papic M, Carek V, Baucic I, Stipetic J. Factors related to patient satisfaction with complete denture therapy. J Gerontol A Biol Sci Med Sci 2003;58:M948–953.
9. John MT, Patrick DL, Slade GD. The German version of the Oral Health Impact Profile: Translation and psychometric properties. Eur J Oral Sci 2002;110:425–433.
10. Slade GD, Spencer AJ. Development and evaluation of the Oral Health Impact Profile. Community Dent Health 1994;11:3–11.
11. John MT, Slade G, Szentpetery A, Setz J. Oral health-related quality of life in patients treated with fixed, removable and complete dentures 1 and 6-12 months after treatment. Int J Prosthodont 2004;17:503–511.
12. Locker D, Matear D, Stephens M, Lawrence H, Payne B. Comparison of the GOHAI and OHIP-14 as measures of the oral health-related quality of life of the elderly. Community Dent Oral Epidemiol 2001;29:373–381.
13. McGrath C, Hegarty AM, Hodgson TA, Porter SR. Patient-centred outcome measures for oral mucosal disease are sensitive to treatment. Int J Oral Maxillofac Surg 2003;32:334–336.
14. McGrath C, Comfort MB, Lo EC, Luo Y. Patient-centered outcome measures in oral surgery: Validity and sensitivity. Br J Oral Maxillofac Surg 2003;41:43–47.
15. Robinson PG, Gibson B, Khan FA, Birnbaum W. A comparison of OHIP 14 and OIDP as interviews and questionnaires. Community Dent Health 2001;18:144–149.
16. Robinson PG, Gibson B, Khan FA, Birnbaum W. Validity of two oral health-related quality of life measures. Community Dent Oral Epidemiol 2003;31:90–99.
17. Armstrong BK, White E, Saracci R. Principles of Exposure Measurement in Epidemiology. Oxford: Oxford University Press, 1992:49–77.
18. Allen PF, McMillan AS, Walshaw D. A patient-based assessment of implant-stabilized and conventional complete dentures. J Prosthet Dent 2001;85:141–147.
19. Laine P. Adaptation to denture-wearing. An opinion survey and experimental investigation. Proc Finn Dent Soc Supplement II 1982;78:77–84.
20. Slade GD. Derivation and validation of a short-form oral health impact profile. Community Dent Oral Epidemiol 1997;25:284–290.
21. Heydecke G, Tedesco LA, Kowalski C, Inglehart MR. Complete dentures and oral health-related quality of life—Do coping styles matter? Community Dent Oral Epidemiol 2004;32:297–306.
22. Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ 1990;54:680–687.
23. Veyrune JL, Tubert-Jeannin S, Dutheil C, Riordan PJ. Impact of new prostheses on the oral health related quality of life of edentulous patients. Gerodontology 2005;22:3–9.
24. Magnusson T. Clinical judgement and patients' evaluation of complete dentures five years after treatment. A follow-up study. Swed Dent J 1986;10:29–35.
25. Toolson LB, Smith DE. A five-year longitudinal study of patients treated with overdentures. J Prosthet Dent 1983;49:749–756.
26. Toolson LB, Taylor TD. A 10-year report of a longitudinal recall of overdenture patients. J Prosthet Dent 1989;62:179–181.
27. Diehl RL, Foerster U, Sposetti VJ, Dolan TA. Factors associated with successful denture therapy. J Prosthodont 1996;5:84–90.
28. Allen PF, McMillan AS. A longitudinal study of quality of life outcomes in older adults requesting implant prostheses and complete removable dentures. Clin Oral Implants Res 2003;14:173–179.