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ORIGINAL ARTICLE

Implant treatment in periodontally compromised subjects—quality of life and patient satisfaction

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Abstract
Objectives The aims of this study were to determine the quality of life of periodontally compromised patients after implant treatment (primary aim) and their satisfaction with the restoration and treatment approach (secondary aim).
Material and methods In this study, 61 adult subjects were evaluated following non-surgical periodontal treatment, under regular maintenance and implant therapy with a fixed restoration. Oral health-related quality of life (OHQoL) was assessed using the German short form of the Oral Health Impact Profile (OHIP-G14). Patient satisfaction with the restoration and treatment procedure was investigated applying a self-designed questionnaire focusing on social-psychological aspects. Statistical analysis of the collected data was performed using Kruskal-Wallis and Man-Whitney *U* test for the relationship between OHIP score and number of implants, patient age and level of education.
Results The average OHIP-G14 score of the examined study population was 2.78 (SD ±4.2), while the item pain had the biggest influence on the number of points. No statistical significance was detected between the relationship of OHIP-G14 score and the number of placed implants ($p = 0.98$). Furthermore, there was no statistically significant correlation between OHIP-G14 score and patient age ($p = 0.67$) or for level of education ($p = 0.39$). The questionnaire focusing on patient satisfaction showed a high level of contentment in this study population. All patients declared that they would repeat the treatment and most (98.4 %) would recommend it to their friends. Furthermore, a high level of satisfaction with aesthetics, stability, cleanability and speech comprehension was reported.
Conclusion The examined study population showed a quality of life after implant therapy comparable to pre-existing reference values of a healthy non-restored population. There was no statistical significance between OHIP-G 14 score and the number of implants, patients' age and education level. Analysis of the satisfaction with the realized implant therapy provided consistently positive results.
Clinical relevance When restoring periodontally compromised patients, implant treatment should be considered to achieve potentially higher oral health-related quality of life compared to for example removable dentures. This needs to be investigated in randomized controlled clinical trials.

Keywords OHIP · Quality of life · Implant treatment · Periodontitis · Patient satisfaction

Introduction

Today, patient-reported outcome measures including quality of life and patient satisfaction with care have become more and more important in all fields of clinical research. Quality of life (QoL) is an individual's perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concern as defined by the World Health Organization [1]. Furthermore, oral health-related QoL (OHQoL) is characterized by a person's perception of how oral health influences

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their QoL and well-being and is influenced by the ability to chew different foods, to speak out clearly, to show a socially acceptable smile and dento-facial profile, to be free of pain and not to suffer from halitosis [2, 3]. Different questionnaires have been developed to specifically address the OHQoL. One of the most commonly used tools is the Oral Health Impact Profile (OHIP) proposed by Slade and Spencer [2] in different versions and translations.

Periodontal disease with its symptoms and signs (e.g. tooth mobility, gingival recession or bad breath) has been shown to affect OHQoL. For example, Needleman et al. [4] reported a considerable effect of oral health on QoL and a correlation between the extent of periodontal disease (teeth with probing depth ≥5 mm) and the impairment of QoL. Patients with severe periodontal disease showed a five times higher OHIP score when compared with a healthy control group and revealed significant differences in functional limitations, physical pain, psychological discomfort and psychological disabilities [5]. Furthermore, loss of periodontal supporting structures has a negative effect not only on masticatory performance but also on QoL [6]. Successful periodontal treatment, however, seems to improve OHQoL [4, 7, 8].

Like periodontal disease, tooth loss impairs oral health [9] and, therefore, many studies have focused on the influence of implant therapy on OHQoL. Single dental implant treatment in the anterior and premolar regions significantly improved subjective oral health [10], and OHQoL is less impaired in patients with a fixed implant-supported restoration compared to removable partial denture wearers [11]. In completely edentulous patients, implant-supported overdentures increase patient satisfaction, dental function and QoL in the mandible [12] and maxilla [13].

Therefore, we primarily sought to assess the OHQoL of periodontally compromised patients after treatment with solely fixed implant-supported prosthesis using the OHIP-G14. As a secondary aim, patient satisfaction with treatment approach as well as with the functional and aesthetic result was evaluated applying a self-designed dichotomous questionnaire.

Material and methods

Subjects

In this investigation, periodontally compromised patients (moderate to severe chronic or aggressive disease [14]) were asked to complete two questionnaires to evaluate their OHQoL and treatment satisfaction 3 months after implant therapy and fixed prosthesis delivery. All participants were treated between September 2010 and July 2012 by two periodontists (SF, KF) in the Department for Periodontology of the Julius-Maximilians-University, Wuerzburg.

To be eligible for this study, patients needed to fulfil the following criteria: (i) successful periodontal treatment (residual probing depths ≤5 mm without bleeding on probing; non-surgical anti-infective therapy followed by possible surgical intervention), (ii) regular supportive periodontal therapy (at least for 6 months after active therapy), (iii) eligible for implant placement and successful restoration and (iv) German as mother language to fully understand the questionnaires. All evaluated subjects received a letter containing an information sheet about the study, a consent form as well as the two questionnaires and a postpaid and self-addressed envelope 3 (±1) months after prosthesis delivery. Four rounds of letters were sent. Each participant signed an informed consent. Patient age, additional procedures (bone or soft tissue augmentation), number of implants and implant location were extracted from the treatment documentation. All data was transferred into one spreadsheet and stored anonymised on one password-protected computer. Data extraction as well as timing of letter dispatch and thereby patient selection was solely executed by one examiner (IL) never having met the subjects in person.

Questionnaires

OHQoL was measured using the German short version of the Oral Health Impact Profile (OHIP-G14) [15]. The OHIP-G14 has 14 items in 7 subgroups focusing on the following: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap [16]. For each OHIP item, participants were asked how frequently they had experienced an impact of that category since treatment completion. Responses were made on a scale of never (0), hardly (1), occasionally (2), fairly often (3) and very often (4), resulting in possible values from 0 to 56 points in total. Summary scores as well as subgroup-specific scores and standard deviations were calculated for statistical analysis.

To assess patient satisfaction, a self-designed questionnaire with 11 dichotomous queries was utilized. The questions were as follows: “Would you repeat the treatment?”, “Would you recommend the treatment to a friend?”, “Would you retrospectively choose a tooth- over a implant-supported restoration?”, “Are you happy with the aesthetic result?”, “Are you happy with the wearing comfort of your restoration?”, “Do you have any problems with speaking/talking because of your restoration?”, “Do you have any problems with chewing/biting because of your restoration?”, “Do you have any problems cleaning your restoration?”, “Are you happy with the stability of your restoration?”, “Was the effort involved in the treatment worth the final result?” and “Were the treatment costs appropriate to the achieved result?”. Answers were either categorized as positive or negative and, if the answer was negative, the participants had the chance to explain the reason on the questionnaire.

Furthermore, educational level was asked and categorized into four different groups according the German school system (9y = "Hauptschule", 9 years; 10/11y = "mittlere Reife", 10/11 years; 12/13y = "Abitur", 12/13 years; >13y = university degree).

Objectives

Primary outcome measure The main objective of this investigation was to determine the QoL of periodontally compromised patients after implant treatment using the OHIP-G14 questionnaire. Furthermore, a relationship between OHIP-G14 score and patient-related factors (number of implants, age, educational level) was examined.

Secondary outcome measure Additional aims were to assess the satisfaction with the restoration and treatment procedure, investigated by a self-designed questionnaire focusing on social-psychological aspects.

Statistical analysis

As already described, mean values, standard deviations as well as medians were calculated per subject for the OHIP-G14. Statistical analysis was performed using SPSS 20 (SPSS GmbH, Munich, Germany). For testing the relationship between OHIP-G14 score on one hand and patient age, number of implants and level of education on the other hand Kruskal-Wallis and Mann–Whitney *U* test were utilized after testing for normal distribution. p values <0.05 were considered as statistically significant.

Results

Baseline data

From 79 possible eligible patients, 2 had lost the implant and were excluded while 77 were contacted and 61 patients (30 females, 31 males) did respond, which is a return rate of 79.2 % (Fig. 1). Average subject age was 59.6 years (±10.2; median 60; min 27; max 77). Overall, 91.8 % of all teeth were extracted before implant treatment because of periodontal reasons and 8.2 % due to root fracture. Of 124 implants, 22 were placed in the anterior (9 maxilla, 13 mandible) and 102 in the posterior region (66 maxilla, 36 mandible). Due to insufficient bone volume, 32 patients needed a sinus augmentation procedure and in 10 participants, guided bone regeneration was performed. Furthermore, in 10 cases, soft tissue augmentation/correction was accomplished. In total, 82 implants were restored with single crowns and 42 were used as abutments for fixed bridges. Concerning the educational level, 29.5 % finished school after 9 years, 32.8 % after 10/11 years,

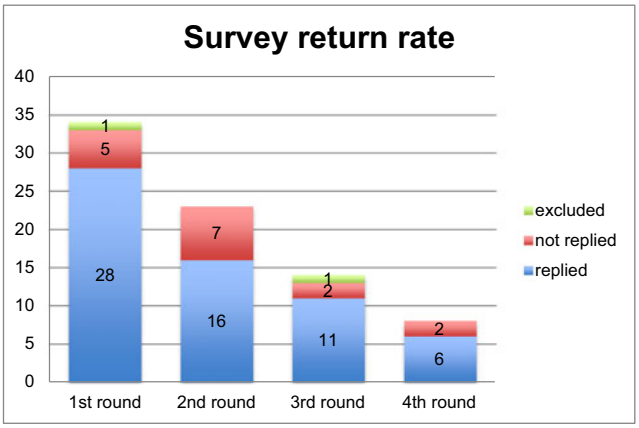

Fig. 1 Number of patients excluded, contacted/replied or contacted/not replied

13.1 % after 12/13 years and 24.6 % completed a university degree.

Primary outcomes

Average OHIP-G14 score was 2.78 points (±4.15; median 1; min 0; max 16) with 42.63 % of the participants having 0 points, 37.7 % having 1 to 4 points and 19.67 % with more than 5 points. In addition, half of the respondents had 0 or 1 point and 90 % less than 8 points. The subscale "pain" was marked most often with an average score of 1 (±1.18; min 0; max 4) followed by "psychological discomfort" (0.43 ± 0.88; min 0; max 4) and "psychological disability" (0.39 ± 1.08; min 0; max 5) (Fig. 2).

Analysing the collected data, no statistically significant difference regarding OHIP scores were found concerning number of placed implants (1 implant: mean = 2.67 ± 4.14; 2 implants: mean = 2.72 ± 4.11; ≥3 implants: mean = 2.92 ± 4.48; median for all groups = 1; $p = 0.98$) or patient age (≤60 years: mean = 2,52 ± 3.93; >60 years: mean = 2.94 ± 4.35; median for all groups = 1; $p = 0.67$). Furthermore, there was no statistically significant difference regarding the OHIP score between the four different groups of educational level; however, there was a trend to lower scores with higher educational level (9y: mean = 4.22 ± 5.31, median = 2.5; 10/11y: mean = 1.9 ± 2.81, median = 0.5; 12/13y: mean = 1.13 ± 0.99, median = 1.5; >13y: mean = 2.93 ± 4.74, median = 0.0; $p = 0.39$).

Secondary outcomes

On 7 out of 11 questions, more than 95 % of the subjects gave positive answers in the self-designed questionnaire (Table 1). Furthermore, all participants (100 % positive answers) would repeat the implant treatment again and 98.4 % would also recommend it to other people, are happy with the aesthetic result as well as with wearing comfort and have no problems

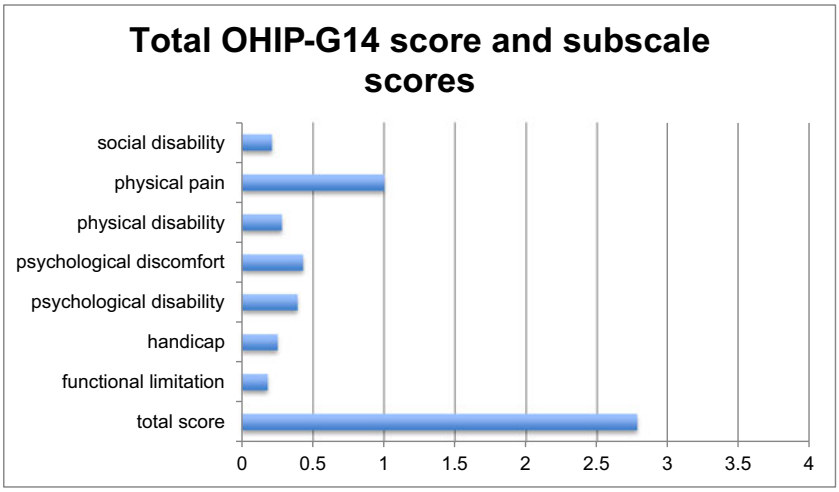

Fig. 2 Mean overall OHIP-G14 scores and corresponding subscales; physical pain seems to be the most relevant point to the respondents

cleaning the restoration. On the other site, 68.8 % rated the treatment costs as too high and mainly because of high expenses for materials and lab work.

Discussion

Key findings

In this analysis, we sought to investigate the oral health-related quality of life (primary aim) and satisfaction (secondary aim) of periodontally compromised patients in supportive therapy after implant treatment. Hence, within the limits of this study, we evaluated high OHQoL presented by low OHIP-G14 scores (2.78 points ±4.15) without any statistically significant difference regarding age, number of implants or educational level within our study population. Furthermore, high satisfaction with the treatment and its outcomes (aesthetics, stability, chewing ability) was found. Nevertheless, high costs for lab work and materials seem to be an issue for many patients.

Comparison with previous studies

The severity and extent of periodontal disease seem to correlate with higher impairment of QoL. For example, Al Habashneh et al. [17] showed an increase of OHIP-14 scores from gingivitis (9.5 ± 7.1) to severe periodontitis (15.6 ± 7.5). Furthermore, Araujo et al. [18] compared a healthy population with periodontally compromised patients in a cross-sectional study. They mainly found a functional limitation in the periodontitis group, and 61.2 % of these patients showed OHIP-14 scores between 36 and 56 while the 78 % of the healthy group had scores below 33.

To evaluate the OHQoL immediately after different periodontal treatment approaches Ozcelik et al. [8] compared non-surgical, surgical and surgical therapy with enamel matrix derivative (EMD). All groups had OHIP-14 baseline scores of 29 to 30. After 1 week, scores for non-surgical and surgical therapy with EMD significantly dropped to 11 and 12, respectively, while the score in the surgical group was still 27.5. This improvement seems to be maintained over time. After 12 months and non-surgical treatment, the OHIP-14 score

Table 1 Responses to the individual questionnaire; high overall satisfaction excluding the treatment costs

	Positive answer (%)	Negative answer (%)
1. Would you repeat the treatment?	100	0
2. Would you recommend the treatment to a friend?	98.4	1.6
3. Would you retrospectively choose a tooth- over a implant-supported restoration?	93.4	6.6
4. Are you happy with the aesthetic result?	98.4	1.6
5. Are you happy with the wearing comfort of your restoration?	95.1	4.9
6. Do you have any problems with speaking because of your restoration?	96.7	3.3
7. Do you have any problems with chewing/biting because of your restoration?	88.5	11.5
8. Do you have any problems cleaning your restoration?	98.4	1.6
9. Are you happy with the stability of your restoration?	98.4	1.6
10. Was the effort involved in the treatment worth the final result?	93.4	6.6
11. Were the treatment costs adequate to the achieved result?	68.8	31.2

dropped from 17 to 13 and improvements in subdomains of physical pain, psychological discomfort and psychological disability accounted for the change [7]. In addition, Needleman et al. [4] found a highly significant difference in OHQoL between new patients and patients under regular maintenance and thereby showing the benefit of successful periodontal treatment not only on tooth survival and surrogate measures (e.g. pocket depth, attachment level) but also on a psychological level.

John et al. [15] screened 2050 people and tried to find reference values for patients without prosthetic restorations as well as for patients having a partial or complete denture. Half of the respondents without denture showed no impairment (OHIP-14 ≤1) of their OHQoL and 90 % had scores less than 11 points. This is consistent with our results (50 % ≤1; 90 % ≤8) and might be because all participants were restored solely with fixed crowns and bridges.

From an implant treatment point of view, Ponsi et al. [10] assessed the influence of single implant restorations in healthy patients on OHQoL. Before treatment, this group showed an overall OHIP-14 score of 10.4, and the value improved significantly to 3.1 3 months after implant crown delivery ($p < 0.001$). This effect was even more pronounced in the anterior region (13.4 to 1.5; $p < 0.001$); however, if the implant was placed in the molar region, the reduction was modest and not statistically significant (6.5 to 3.0; $p = 0.85$). On one side, similar improvements might be expected in our study especially in the anterior region and because mainly single implant restorations were made. On the other side, due to functional limitations like tooth mobility as shown by Borges Tde et al. [6], improvements in the posterior region might be more pronounced in periodontally compromised patients while aesthetic demands might be less important. This speculation needs to be proven in future studies. Comparing implant-supported fixed dentures (ID) and removable partial dentures (RPD), Furuyama et al. [11] found nearly a twofold OHIP-49 score for RPD wearers and they frequently reported problems with food impaction, chewing difficulties and avoidance of eating certain food. Again, especially problems with chewing and biting, as often reported by periodontitis patients, seem to affect denture wearers and, hence, patients with fixed restorations—either tooth or implant supported—seem to be less hindered.

On average, two implants were placed per subject, and in most cases, further procedures like bone and soft tissue augmentation was needed, hence were complex to advanced cases. Regarding patient satisfaction, nevertheless, all patients reported that they would repeat the procedure and would also recommend it to friends. Furthermore, most respondents (>95 %) were happy with the functional and aesthetic results as well as we were not able to find a statistically significant difference between patients with different numbers of implants concerning OHQoL. Future research might evaluate the influence of different approaches and case complexity.

Strengths and limitations of the study

Within this investigation, the participants reported very low OHIP scores. Because of the study design, it is not possible to say whether or not this is a true finding and corresponds with a high OHQoL due to successful periodontal followed by implant treatment or is an artefact meaning that either the participants did not feel impaired by their periodontal disease/tooth loss and would have reported similar low scores before treatment or that maybe the applied questionnaires were not the right tool. Also, patients missing only one posterior tooth might show lower baseline OHIP scores compared to patients having lost multiple teeth or one single anterior tooth. Nevertheless, due to the good reproducibility of the OHIP questionnaire, it is possible to relate the presented data with different studies or reference values [15], but controlled or longitudinal studies are needed to approve our findings and conclusions. Additionally, the self-designed satisfaction questionnaire was introduced for the first time and has not been tested or validated before. A further limitation might be a potential selection bias of included participants. One examiner who was not involved in the treatment and had never met the patients in person, however, performed the inclusion process and solely decided when to send the next round of letters. Furthermore, on one side, participants might have been less influenced to give "better notes" answering the questions not being at the practice and without any help, while on the other side it is not clear whether or not each participant understood the questionnaires because they were sent without further explanation.

To the authors' best knowledge, this is the first investigation focusing exceptionally on the OHQoL of periodontally compromised patient after implant therapy with fixed restorations including single/multiple implant placement and single crowns or bridges. These patients might show impaired QOL because of both their periodontal disease and tooth loss and, therefore, might especially benefit from successful treatment. Today, most studies either report on the QOL before/after periodontal treatment or compare removable dentures (tooth versus implant supported) and only little is known about the effect of prosthetic rehabilitation after periodontal therapy.

Conclusion

In conclusion, the presented data reveals that successfully treated periodontally compromised patients under regular supportive therapy show a high oral health-related quality of life 3 months after implant placement and fixed restoration delivery according to pre-existing reference values [15]. This effect was independent of age, number of implants and educational

level. Furthermore, participants showed a high level of satisfaction with the treatment; however, treatment costs and especially expenses for materials and lab work were an issue for nearly one third of the subjects. Further controlled and/or longitudinal investigations are needed to better understand the effect of different prosthetic treatment approaches on the oral health-related quality of life of periodontally compromised patients.

Conflict of interest The authors declare that they have no competing interests.

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