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Evaluation of the Effects of Attachment Type and Implant Number on Life Quality of Implant-Supported Mandibular Overdenture Prosthesis Patients

Beyza Ünalan Değirmenci1*, Murat Eskitaşçıoğlu1

1 Van Yüzüncü Yil University Faculty of Dentistry, Department of Prosthodontics, Van, TR

*** Corresponding Author:** Beyza Ünalan Değirmenci **E-mail:** beyzaunalan@hotmail.com

ABSTRACT

Objective: The current study aimed to evaluate the life quality of implant-assisted mandibular overdenture patients who have had additional implant applications and were rehabilitated with ball or bar attachment.

Material and Methods: 53 patients who came to Van Yüzüncü Yil University, Faculty of Dentistry, Prosthodontics Clinic for implant-supported mandibular overdenture treatment between 2019 and 2021 were included in this prospective clinical study (32 females, 30 males; mean age: 64.03; age range: 33-90). The patients were called back for the study precisely one year after prosthetic loading of their implants. Implant-supported mandibular overdenture prosthesis patients diverged into six groups: splinted two implants (bar attachment), single two implants (ball attachment), splinted three implants (bar attachment), single three implants (ball attachment), splinted four implants (bar attachment) and single four implants (ball attachment). And they asked for completing the Turkish version of the OHIP-14 questionnaire.

Results: Ball attachment was used in 45.28% of the participants, a mandibular overdenture design supported by a bar attachment was preferred in 54.72%. Kruskal-Wallis test results indicated that the number of implants had a statistically significant effect only on functional limitation and psychological disability among the seven OHIP-14 categories evaluated ($p=0.018$, $p=0.009$). Accordingly, the average functional limitation score in individuals with four implants was 4.44 ± 1.89.

Conclusion: We found that there are a positive correlation between the number of implants and the patient's life quality; however, it can be concluded that attachment type does not significantly affect the scores of the life quality.

Keywords: Dental Implants, Quality of Life, Quality Improvement

INTRODUCTION

The total loss of natural teeth and the consequent alveolar bone resorption are considered an oral health disorder (1). Although it is stated that the incidence is higher in individuals over the age of 65, it is known that it affects all age groups (2). Recent studies report the distinctions in the incidence of total edentulism by country and point out the problems that individuals experience due to this condition (3). It is a scientific fact that tooth loss triggers nutritional disorders and induces functional and sensory changes in the oral mucosa. All these changes restrict the patient's daily activities such as chewing and speaking and cause aesthetic concern in the patient hence, total edentulism was recognized as a physical disability by the World Health Organization (WHO) in 2001 (4). Kutkut et al., in a systematic review study which they evaluated the effects of total edentulism, conveyed that there was a significant decrease in the life quality of edentulous patients who were not rehabilitated (5).

Recent research highlights the importance of considering patient satisfaction and/or oral health-related life quality as an outcome variable to understand patients' needs and post-rehabilitation satisfaction and assess the impact of treatment on patients' life quality (6). Studies carried out over the past three decades, rooted in this focus, have utilized questionnaires such as the Oral Health Impact Profile (OHIP) to assess impacts (7).

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Fueki et al. (8) and Armellini et al. (9) reported that OHIP in patients with removable partial dentures in implant-supported prosthesis patients was effective in patient-based evaluation of treatment efficacy. As it is known, the most common rehabilitation method in the treatment of total edentulism is traditional total dentures. However, high success has been achieved thanks to increased patient awareness and dental implantology. As a result, a significant increase has been achieved in today's treatment scenarios (1). However, total edentulism is more common in countries with relatively worse socio-economic conditions, so there may be a need for cheaper treatment costs (10). As proof of this finding, Dye et al. conducted a pioneering study in which individuals aged 50 and over evaluated the benefits of rehabilitation for total edentulism. In this study, he noted that the economic situation of the person played an important role in the recovery related to rehabilitation and defined the economic situation as a factor in the success of rehabilitation (11). This means that the number of implants planned in implant-assisted overdenture prostheses and the type of attachment used in its design are critical (12).

Implant-assisted mandible overdenture prostheses have a large number of attachment types available for the interforaminal region, depending on the preference of clinicians (13). Bilhan et al. reported that the most frequently preferred attachments in the market are bar, ball, magnet and locator attachments (14). Although attachment type preference today has become the hot topic of dental implantology, the research results published in this regard are quite contradictory (12). Moreover, according to the current authors, there are only two studies evaluating the effects of attachment type and the number of implants on the quality of life of implant-assisted mandibular overdenture patients. This is a significant impediment for clinicians to operate evidence-based implantology procedures. Based on this deficiency in the literature, the current study aimed to evaluate the life quality of implant-assisted mandibular overdenture patients who have had additional implant applications and rehabilitated with ball or bar attachment.

The first null hypothesis of the study is that the attachment type does not affect the quality of life of implant-assisted mandibular overdenture prosthesis patients. The secondary null hypothesis is that there will not be any distinction in the life quality of the patients depending on the number of implants.

MATERIAL and METHODS

Sixty-two patients who came to Van Yüzüncü Yil University, Faculty of Dentistry, Prosthodontics Clinic for implant-supported mandibular overdenture treatment between 2019 and 2021 were included in this prospective clinical study (32 females, 30 males; mean age: 64.03; age range: 33-90) The criteria for inclusion of the study are as follows: determination of mandible total edentulism, absence of any systemic diseases that may endanger the outcome of the implant, reading and signing written approval, having sufficient interocclusal distance and not having a history of using moving prosthesis before. However, patients with poor oral hygiene, current complaints of orofacial pain, acute oral infections and who refused to participate in follow-up check-ups were excluded from the study. All patients were provided with detailed information before the study and were requested to sign an informed consent form. The study protocol was approved by the Van Yüzüncü Yıl University Clinical Research Ethics Committee (18.12.2019/02).

The patients were called back for the study precisely one year after prosthetic loading of their implants. Implant-supported mandibular overdenture prosthesis patients diverged into six groups: splinted two implants (bar attachment), single two implants (ball attachment), splinted three implants (bar attachment), single three implants (ball attachment), splinted 4 implant (bar attachment) and single four implants (ball attachment). Experienced prosthetists carried out all clinical procedures, and all laboratory procedures were performed by the same qualified and experienced dental laboratory technicians. All prosthesis designs by the bilateral balanced occlusion scheme are cautiously developed. At the end of 1 year, the clinical examinations of the patients who were called for the control session were carried out by two experienced prosthesis faculty members. Prosthetic parameters such as retention, tissue compatibility, occlusion of the prosthesis and the condition of the stressed soft tissues were also carefully checked.

In the study, instead of the original OHIP questionnaire with 49 questions, the Turkish version of the OHIP-14 questionnaire, which offers reader convenience, includes the same seven categorical (functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap) evaluations, and has proven validity-reliability was used (15). The same five categories of answers were formed for each question: "never", "seldom", "occasionally", "quite often" and "very often". Responses were scored on a five-point scale ranging from 0 = 'never' to 4 = 'very often'. And a lower OHIP-14 score was considered to represent a higher life quality.

Statistical Analysis: The data were analyzed using IBM SPSS V23. While the conformity to the normal distribution was examined with the Shapiro-Wilk test, the Chi-square test was used to compare the categorical variables according to the groups.

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The Mann-Whitney U test was used to compare the data that was not normally distributed according to the paired groups, and the Independent Two-Sample T-test was used to compare the data that was not normally distributed. Kruskal-Wallis test was preferred in the comparison of the data that were not normally distributed according to groups of three or more, and multiple comparisons were examined with Dunn's test.

One-way analysis of variance has been used to compare the normally distributed data in groups of three or more. Analysis results were presented in mean ± standard deviation and median (minimum-maximum) for quantitative data and categorical data as frequency (percentage). The significance level was accepted as $p<0.050$.

RESULTS

At the end of 1 year, a total of 53 patients, 25 male and 28 female, participated in the study and the study was completed with the loss of 9 participants. It was recorded that 18 of the volunteers with a mean age of 67.78 had two implants, 16 had three implants and 19 had four implants. There was no statistical difference between the groups determined by the number of implants in terms of gender and age ($p=0.642$, $p=0.0549$) (**Table 1**).

Moreover, ball attachment was used in 45.28% of the participants, a mandibular overdenture design supported by a bar attachment was preferred in 54.72%.

The Chi-Square test results revealed that there was no significant age and gender difference between the groups according to the type of attachment used ($p=0.719$, $p= 0.859$) (**Table 2**).

Kruskal-Wallis test results indicated that the number of implants had a statistically significant effect only on functional limitation and psychological disability among the seven OHIP-14 categories evaluated ($p=0.018$, $p=0.009$). Accordingly, the average functional limitation score in individuals with four implants was 4.44 ± 1.89, and in individuals treated with two implants, this score was 6.21 ± 1.78 (**Table 3**).

There was no significant difference according to the number of implants in the categories of physical pain, psychological discomfort, physical disability, social disability and handicap ($p>0.05$). Nonetheless, while the psychological disability score treated with four implants was 2.69 ± 0.70, this score was 4.05 ± 1.87 in patients with overdentures supported by two implants is especially unusual (**Table 3**).

However, the Mann-Whitney U test revealed that ball or bar attachment preference did not have a statistical significance in the seven categorical evaluations of the patient ($p>0.05$) (**Table 4**).> Lower physical pain, psychological discomfort, physical disability, psychological and social disability scores were calculated in bar attachment patients. However, this difference was not statistically significant ($p>0.05$).

Table 1. Comparison of demographic characteristics according to the number of implants

	Implant Number			Total	Test Statistics	*P value*
	2	3	4			
Gender						
Male	9 (50)	6 (37.5)	10 (52.6)	25 (47.2)	0.886	0.642*
Female	9 (50)	10 (62.5)	9 (47.4)	28 (52.8)		
Age	67.78 ± 10.76	60.13 ± 11.38	58.63 ± 13.62	62.19 ± 12.50	3.002	0.059**
	66.00 (45.00 – 87.00)	61.50 (39.00 – 76.00)	62.00 (33.00 – 76.00)	62.00 (33.00 – 87.00)		

*Chi-Square test, **One Way ANOVA results, mean ± standard deviation, median (min-max), frequency (percentage)

Table 2. Comparison of demographic characteristics by attachment type

	Attachment Type		Total	Test Statistics	*P value*
	Ball	Bar			
Gender					
Male	11 (45.8)	14 (48.3)	25 (47.2)	0.031	0.859*
Female	13 (54.2)	15 (51.7)	28 (52.8)		
Age	61.50 ± 14.46	62.76 ± 10.84	62.19 ± 12.50	-0.362	0.719**
	63.50 (33.00 – 82.00)	62.00 (39.00 – 87.00)	62.00 (33.00 – 87.00)		

* Chi-Square test, ** Independent two-sample t-test, mean ± standart deviation, median (minimum – maximum), frequency (percentage)

Table 3. Results of OHIP categories for all groups according to implant number

Domain	Implant Number 2	3	4	Test Statistics	*P value**
Functional Limitation	6.21 ± 1.78 6.00 (2.00 – 8.00)[b]	5.63 ± 1.96 6.00 (2.00 – 8.00) [ab]	4.44 ± 1.89 4.00 (2.00 – 8.00) [a]	8.066	**0.018**
Physical Pain	5.39 ± 2.17 6.00 (2.00 – 8.00)	6.06 ± 2.02 6.50 (2.00 – 8.00)	6.89 ± 1.20 7.00 (5.00 – 8.00)	4.673	0.097
Psychological Discomfort	3.67 ± 1.68 3.00 (2.00 – 8.00)	3.75 ± 1.39 4.00 (2.00 – 6.00)	4.16 ± 1.61 4.00 (2.00 – 8.00)	1.179	0.554
Physical Disability	2.94 ± 1.89 2.00 (2.00 – 8.00)	2.25 ± 0.58 2.00 (2.00 – 4.00)	3.79 ± 2.42 2.00 (2.00 – 8.00)	3.981	0.137
Psychologic Disability	4.05 ± 1.87 3.00 (2.00 – 8.00)[b]	4.00 ± 1.50 4.00 (2.00 – 7.00) [b]	2.69 ± 0.70 3.00 (2.00 – 4.00)[a]	9.336	**0.009**
Social Disability	2.83 ± 1.38 2.00 (2.00 – 7.00)	2.25 ± 0.45 2.00 (2.00 – 3.00)	2.95 ± 1.72 2.00 (2.00 – 7.00)	1.177	0.555
Handicap	3.22 ± 1.26 3.00 (2.00 – 7.00)	3.31 ± 1.01 3.00 (2.00 – 5.00)	4.16 ± 1.46 4.00 (2.00 – 8.00)	5.676	0.059

*Kruskal Wallis test a-b: There is no difference between the number of implants with the same letter, mean ± s. deviation, median (min-max)

Table 4. Results of OHIP categories for all groups according to attachment type

Domain	Attachment Type Ball Attachment	Bar Attachment	Test Statistics	*P value**
Functional Limitation	5.33 ± 1.88 5.50 (2.00 – 8.00)	5.52 ± 2.10 6.00 (2.00 – 8.00)	323.5	0.657
Physical Pain	6.33 ± 2.10 7.00 (2.00 – 8.00)	5.97 ± 1.74 6.00 (2.00 – 8.00)	278	0.200
Psychological Discomfort	4.04 ± 1.68 4.00 (2.00 – 8.00)	3.72 ± 1.46 3.00 (2.00 – 8.00)	308.5	0.470
Physical Disability	3.25 ± 2.11 2.00 (2.00 – 8.00)	2.86 ± 1.77 2.00 (2.00 – 8.00)	289.5	0.221
Psychologic Disability	3.63 ± 1.79 3.00 (2.00 – 7.00)	3.62 ± 1.40 3.00 (2.00 – 8.00)	314.5	0.536
Social Disability	2.83 ± 1.46 2.00 (2.00 – 7.00)	2.59 ± 1.24 2.00 (2.00 – 7.00)	323	0.582
Handicap	3.54 ± 1.56 3.00 (2.00 – 8.00)	3.62 ± 1.12 4.00 (2.00 – 6.00)	299	0.364

*Mann-Whitney U testi, mean ± s. deviation, median (minimum – maximum)

DISCUSSION

Patients often have problems using traditional mandibular total dentures developed for total edentulism. An alternative option, implant-supported mandibular overdenture prostheses, promises more stabilization and retention (13). As a result of the current study originating from this focus, it was determined that there was a difference in the OHIP-14 scores of the patients due to the use of ball or bar attachments. Therefore, the first null hypothesis of the study was accepted. However, the findings revealed that patients with four implants scored lower on functional limitation and psychological disability from the seven assessment categories of OHIP-14 compared to cases rehabilitated with two implants (p=0.018, p=0.009). Therefore, the secondary null hypothesis of the research was rejected partially.

It is known that the type of attachment in implant-supported overdenture prosthesis has effects on the retention of the prosthesis, chewing efficiency, adaptation to phonation, aesthetics and ease of hygiene (16).

Research on this subject has often focused on the negative effects of magnet attachments (17). However, as emphasized by current studies, locater, ball and bar attachments are frequently preferred by dentists in overdenture prostheses. The evaluation of this situation by researchers is very important in terms of forming a guide for clinicians. In the current study, overdenture patients rehabilitated with ball and bar attachments were included to compensate for this deficiency in the literature. According to the York Consensus, implanting two implants in patients with implant-supported mandibular overdentur is a standard procedure for minimal care in the rehabilitation of edentulous patients (18). However, there are meta-analyses indicating that there is an improvement in peri-implant health parameters when the number of implants is increased to 3 and 4 (19). In the light of this information, patients who were rehabilitated with two implants, as well as patients with mandibular overdenture prosthesis supported by 3 and 4 implants, were included in our study.

Although it is assumed that the changes in the field of implantology will have an impact on the patients, there are very limited studies on the effects of the number of implants used in rehabilitation on the patients' life quality. El Syad et al. conducted a study evaluating the OHIP-14 scores of users of total dentures, fixed dentures, and bar-supported overdenture prostheses. In this study, he reported that the highest scores representing the worst quality of life were in total prosthesis patients, and there was an important decrease in OHIP-14 scores as the number of implants increased. Additionally, supporting this finding, they emphasized that the patient group with the highest life quality was fixed prosthesis users (20). Mumcu et al. also stated that the increase in the number of implants provoked a significant decrease in the OHIP-14 scores. They also discovered a similar effect in the visual analogue scale scores that they evaluated in their study. They reported that the lowest OHIP-14 score was obtained after bar supported overdenture prosthesis application, which also supports this (13). In the present study, a decrease in the OHIP-14 scores of the patients was received with the increased number of implants. This situation can be interpreted as the patients' life quality increases as the number of implants increases, which is in line with the results of all these studies. On the other hand, Swelem et al. stated that the number of implants is an effective factor in the total OHIP-14 scores, however when evaluated categorically, the effect was not detected in all seven categories. The study findings emphasized that with the increase in the number of implants, a statistically significant decrease was seen only in the scores of functional limitation, psychological discomfort, and physical disability (12). A similar study conveyed that the number of implants did not cause a significant score change in any category (21). In the current study, a significant difference in scores was obtained only in the functional limitation and psychological disability categories with the increase in the number of implants. This difference in the findings may be related to the difference that may occur in the tolerance levels of the participants depending on the age and gender difference, as well as the duration of using the prostheses of the patients who participated in the research.

A wide variety of attachment systems are available for the retention and support of overdenture prostheses; however, there is still no clear consensus on the effects of these attachments on functionality, biomechanics, clinical life and patient comfort (22). Gonçalves et al., in their systematic review study deriving from this deficiency, the clinical performances of attachment systems and their effects on patient satisfaction were evaluated, and it was noted that attachment preference did not have a substantial effect on patient satisfaction (23).

In a 10-year clinical follow-up study by Cune et al, it has been reported that patients with mandibular overdenture prosthesis designed with bar/ball attachment supported by 2 implants have equal satisfaction at the end of this process (24).

In the longitudinal prospective pioneer study conducted by Bergendal et al, it was emphasized that similar satisfaction scores were obtained in maxillary/mandibular overdenture prosthesis patients supported with different numbers of implants (2-5) and attachment types (25).

However, none of these studies directly evaluated the effects of attachment preference on patients' life quality. The patient satisfaction parameter, which has a positive correlation with the quality of life, was employed (26). Regarding this existing positive correlation, it can be stated that these findings are in parallel with the results of the current study. In the study performed by Bilhan et al., where the patients' life quality with mandibular overdenture prosthesis supported by two different attachment systems and two implants was evaluated, no significant difference was discovered in OHIP-14 scores depending on the attachment type, which is proof for this assertion (14). However, in a different study evaluating the effects of attachment type and the number of implants on the patients' life quality, it has been reported that the quality of life increases significantly and significantly eliminates psychological discomfort in mandibular overdenture prostheses designed with bar-type attachment supported by four implants of the attachment type (13). This difference in our findings may be due to the retrospective nature of the study design.

There are some main limitations of the present study. The first is that the patient group rehabilitated with conventional total dentures was not included in the study and the comparative effects of mandibular overdenture prostheses with traditional treatment procedures were not evaluated. Another limitation is that the effects of the restoration status of the maxillary arch and the implant positions used in the mandibular arch were ignored in the study.

CONCLUSION

Within the limitations of this study, a positive correlation between the number of implants and the patient's life quality has been found; however, it can be concluded that attachment type does not have a significant effect on the scores of the life quality.

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Ethical approval: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by Local Ethical Committee. All procedures performed in studies with human participants met the ethical standards of the Institutional Research Commission and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards. This study was approved by Van Yüzüncü Yil University Van Yüzüncü Yıl University Clinical Research Ethics Committee (18.12.2019/02).

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