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Does number of implants or type of attachment affect patient satisfaction with implant-retained mandibular overdentures?

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ABSTRACT

Aim This study aimed to determine, from the patients' perspective, the optimal number of implants and the type of attachment used to support a mandibular overdenture.

Materials and methods This study was conducted with 166 patients who had received new implant-retained overdentures (IODs) in the mandible and conventional total prostheses in the maxilla, and have been using for at least 1-year. Three types of attachment (ball attachment, bar holder, and locator) were connected to either two or four implants. Patients completed the OHIP–14 questionnaire, and the results were statistically analyzed.

Results Patients were, in general, satisfied with their mandibular IODs (OHIP-ADD: 7.07 ±9.09, OHIP-SC: 0.95 ±2.11). While the satisfaction rate was higher for males ($P < 0.05$), there was no difference for age factor ($P > 0.05$). Higher satisfaction was observed for 4-implant support ($P = 0.014$), especially with bar holders (OHIP-SC: 0.13 ±0.43). No difference was found between the locator and ball attachment in prostheses with 2-implant ($P > 0.05$).

Conclusion Four implant-support, in particular, with bar-holders, exhibited higher satisfaction. There was no difference between locator and ball attachment in terms of patient satisfaction.

KEYWORD Ball attachment, Bar holder, Dental implant number, Implant-supported denture, Locator.

INTRODUCTION

The widespread use of dental implants has caused a gradual decrease in the demand for conventional removable prostheses. It has been emphasized in many studies that implant-supported overdenture (IOD) prostheses should be the most basic treatment option for the rehabilitation of edentulous patients (1-6).

In several studies, it has been argued that the choice of the type of attachment and the number of implants to support IODs directly affects various aspects, such as biomechanical complications (7-9), maintenance requirement (10, 11), cost (9, 12), retention level of the prosthesis (13, 14), chewing ability (4, 5), and comfort of the patient (15, 16). However, so far, there is no consensus in the literature on the number of implants and the type of attachment most suitable for an optimal mandibular IOD. Different studies have suggested the use of a variable number of implants to support mandibular IODs (13, 16-18). Similarly, several types of attachment, such as ball attachment (7, 10, 15, 19), locator (11, 20, 21), bar holder (7, 16, 22), have been recommended.

The aim of the present study was, therefore, to compare the effects of different types of attachment (ball attachment, locator, and bar holder) and number of implants (2 or 4) on the quality of life of the patients and their satisfaction with their prostheses, in patients using the IOD in the mandible and total removable prostheses in the maxilla, using the Oral Health Impact Profile–14 (OHIP–14) evaluation method.

MATERIALS AND METHODS

The present study was conducted on totally edentulous patients who were rehabilitated with dental implants to support their mandibular IODs. All the patients received new prostheses after implant placement. The patients were called-in for at least yearly check-up appointments and if necessary, implant attachments were maintained, and the worn-out retentive structures were replaced.

The inclusion criteria for the present study were as follows: completely edentulous patients, who received

	2 BALL	2 LOC	4 BAR	4 LOC	Total
Female	38	40	17	13	108 (%65)
Male	17	18	13	10	58 (%35)
Under 65 (average age)	26 (55,5)	37 (56,9)	13 (59.2)	11 (57.9)	87 (%52)
OVer 65 (average age)	29 (71)	29 (71)	17 (72.1)	12 (70.7)	79 (%48)
Average age	63.6	71.7	66.5	64.6	63.7
Duration of use (<3 year)	23	44	17	14	98
Duration of use (> 3 year)	32	14	13	9	68
Smoker	33	37	18	10	98
Non-smoker / ex-smoker	22	21	12	13	68
Working	24	24	11	14	73
Non-Working / Housework / Retired	31	34	19	9	93
Total	55	58	30	23	166

TABLE 1 Socio-demographic data of the patients.

IODs for the mandible and conventional total prosthesis for the maxilla, and were literate, mentally healthy, and able to complete the questionnaires without assistance, and had used the new IODs for at least one year.

Exclusion criteria for the present study were as follows: Loss of implant during the functional life of the prosthesis, inadequate oral hygiene, temporomandibular joint disease. Based on these criteria, a total of 166 patients were included in the present study.

In order to measure the level of satisfaction among the patients on the use of their prostheses, a specific scale referred to as OHIP–14 was used. OHIP–14 is frequently used for assessing the status of oral health, and its reliability and validity in different languages have been validated (4, 6, 23-27). OHIP–14 is a self-report questionnaire that contains 14 questions focusing on oral health-related quality of life based on 7 indicators (Functional Limitation, Physical Pain, Psychological Discomfort, Physical Disability, Psychological Disability, Social Disability, and Handicap). A Likert response system was used for the evaluation of the questionnaire, in which 0 represented the response "Never", 1 represented "Rarely", 2 represented "Sometimes", 3 represented "Frequently", and 4 represented "Very frequently." The data obtained in the present study were used to compare the levels of satisfaction among the participants with their respective IODs, and also, the levels of satisfaction with the IODs between genders and between individuals under and over the age of 65 years.

Finally, the patients were categorized into four groups based on the types of attachment and the number of implants in their IODs and the overall satisfaction, as well as satisfaction based on gender and age were compared as described earlier:

- 2BALL: Patients using two implant-supported ball attachments;
- 2LOC: Patients using two implant-supported locators;
- 4LOC: Patients using four implant-supported locators;
- 4BAR: patients using four implant-supported bar holders.

Several methods have been proposed in the literature for the evaluation of the OHIP–14 surveys. In the present study, both OHIP-ADD and OHIP-SC evaluation methods, which have been utilized frequently in the literature, were used. The Simple Count Method (OHIP-SC) is an evaluation technique in which the total score is calculated by adding the number of responses reported as "Sometimes" or "Frequently". These responses are scored with 1 point for each question, and the highest score possible is 14 points, while the lowest score possible is 0. In the second method, the Additive Method (OHIP-ADD), the numerical values of the responses are added and evaluated according to the Likert response system. In this context, the highest score possible is 56, while the lowest score possible is 0. In both scoring methods, a higher score indicated the more significant effect and lower quality of life associated with oral health (26, 27).

Statistical analysis was performed using data from a single database (Excel; Microsoft Corp.) in commercial software (SPSS-Mac v21; Statistical Package for Social Sciences Inc). The data description consisted of sample distribution for nominal data and the mean ±standard deviation (SD) quantitative data. One-way ANOVA was used for comparisons of the quantitative parameters exhibiting a normal distribution of data between the groups. Kruskal–Wallis test was used for comparisons of the abnormally distributed parameters between the groups, and the Mann–Whitney U test was used for determination of the group responsible for the difference. Wilcoxon signed-rank test was used for intragroup comparisons. The chi-squared test was used for comparisons of the qualitative data. Statistical significance was set at $p<0.05$.

Descriptive statistics		OHIP SC				OHIP ADD			
	N	MINIMUM	MAXIMUM	MEAN	SD	MINIMUM	MAXIMUM	MEAN	SD
Functional limitation	166	0.00	2.00	0.13	0.37	0.00	8.00	1.09	1.61
Physical pain	166	0.00	2.00	0.22	0.50	0.00	8.00	1.83	1.92
Psychological discomfort	166	0.00	2.00	0.13	0.43	0.00	8.00	0.86	1.86
Physical disability	166	0.00	2.00	0.09	0.31	0.00	8.00	0.69	1.37
Psychological disability	166	0.00	2.00	0.16	0.48	0.00	8.00	1.20	1.95
Social disability	166	0.00	2.00	0.07	0.31	0.00	8.00	0.39	1.31
Handicap	166	0.00	2.00	0.16	0.40	0.00	8.00	1.02	1.56
OHIP14	166	0.00	14.00	0.95	2.11	0.00	56.00	7.07	9.09

TABLE 2 Scores of the participants for OHIP–14 questionnaire according to both OHIP-SC and OHIP-ADD evaluation methods.

	Age (OHIP ADD)					Age (OHIP SC)				
	Under 65		Over 65		p	Under 65		Over 65		p
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Functional limitation	1.23	1.69	0.90	1.50	0.,217	0.17	0.41	0.07	0.31	0.041
Physical pain	1.93	2.01	1.71	1.79	0.604	0.26	0.53	0.18	0.45	0.324
Psychological discomfort	0.96	1.96	0.72	1.72	0.301	0.15	0.46	0.11	0.40	0.611
Physical disability	0.79	1.50	0.56	1.19	0.345	0.13	0.37	0.04	0.20	0.083
Psychological disability	1.27	2.02	1.11	1.86	0.759	0.16	0.49	0.15	0.46	0.947
Social disability	0.54	1.60	0.18	0.74	0.104	0.10	0.39	0.03	0.17	0.272
Handicap	1.33	1.82	0.61	1.03	0.009	0.21	0.46	0.08	0.28	0.047
OHIP14	8.04	10.14	5.79	7.37	0.232	1.17	2.41	0.67	1.62	0.232
**Mann Whitney U test*										

TABLE 3 Scores of participants grouped according to age factor to OHIP–14 questionnaire considering both OHIP-SC and OHIP-ADD evaluation methods.

RESULTS

The socio-demographic profiles and follow-up periods of the groups are presented in Table 1.

When all the 166 participants were evaluated, an average score of 7.07 ±9.09 was obtained in the questionnaire out of the 56 points according to the OHIP-ADD, while a score of 0.95 ±2.11 was obtained out of the 14 points according to the OHIP-SC. The sub-category of "Physical Pain" reached the highest score of 1.83 ±1.92 according to the OHIP-ADD and a score of 0.22 ±0.50 according to the OHIP-SC (Table 2).

When the participants were divided by age, a statistically significant higher level of dissatisfaction was observed in the "Handicap" sub-category in the patients aged less than 65 years (OHIP-ADD: 1.33 ±1.82; p=0.009, OHIP-SC: 0.21 ±0.46; p=0.047). Also, the "Functional Limitation" sub-category exhibited significantly higher dissatisfaction in the patients over 65 years old (OHIP-SC: 0.17 ±0.41 vs 0.07 ±0.31; p=0.041) (Table 3).

When the 166 participants were evaluated based on the gender factor, female patients were observed to exhibit statistically higher levels of dissatisfaction according to the main OHIP–14 results (OHIP-ADD: p=0.025, OHIP-SC: p=0.033). Also, females exhibited statistically higher dissatisfaction according to OHIP-ADD in the sub-categories of "Physical Pain", "Psychological Disability" and according to OHIP-SC in the sub-categories of "Functional Limitation", "Psychological Discomfort", "Psychological Disability", and "Social Disability" (Table 4).

Although the differences are not statistically significant, according to OHIP-ADD, in the overall OHIP-14 scores between the groups, the scores are lower in favor of 4-implant groups. On the other hand, according to the OHIP-SC, these differences are statistically significant and high satisfaction was observed in the overall scores of OHIP-14 in favor of 4-implant groups (p=0.014), especially in the 4BAR group (0.13 ±0.43) (Table 5).

When the evaluation was made between groups

	Gender (OHIP ADD)				p	Gender (OHIP SC)				p
	Female		Male			Female		Male		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Functional limitation	1.28	1.79	0.74	1.16	0.103	0.18	0.43	0.03	0.18	0.018
Physical pain	2.07	1.99	1.38	1.69	0.024	0.26	0.54	0.16	0.41	0.223
Psychological discomfort	1.09	2.12	0.41	1.09	0.058	0.19	0.51	0.03	0.18	0.044
Physical disability	0.76	1.45	0.55	1.22	0.439	0.12	0.35	0.03	0.18	0.090
Psychological disability	1.49	2.23	0.66	1.07	0.032	0.22	0.57	0.03	0.18	0.022
Social disability	0.51	1.55	0.16	0.62	0.333	0.10	0.39	0.00	0.00	0.034
Handicap	1.12	1.67	0.83	1.34	0.305	0.18	0.43	0.12	0.33	0.498
OHIP14	8.32	10.21	4.72	5.90	0.025	1.24	2.47	0.41	1.01	0.033
*Mann Whitney U test										

TABLE 4 Scores of participants grouped according to gender factor to OHIP–14 questionnaire considering both OHIP-SC and OHIP-ADD evaluation methods.

	Implant groups (OHIP ADD)								
	2 BALL		2 LOC		4 BAR		4 LOC		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p
Functional limitation	1.13	1.82	1.43	1.84	0.70	0.92	0.65	0.93	0.345
Physical pain	1.62	2.26	2.12	2.09	1.67	1.03	1.83	1.34	0.224
Psychological discomfort	0.95	2.11	1.05	2.01	0.50	0.86	0.61	1.75	0.688
Physical disability	0.89	1.71	0.76	1.42	0.20	0.41	0.65	1.07	0.510
Psychological disability	1.27	2.31	1.36	2.01	0.87	0.73	1.04	1.94	0.555
Social disability	0.58	1.52	0.43	1.53	0.10	0.31	0.17	0.83	0.438
Handicap	0.82	1.60	1.12	1.66	1.00	0.87	1.26	1.94	0.104
OHIP14	7.25	10.56	8.28	10.14	5.03	3.30	6.22	7.40	0.607
	Implant groups (OHIP SC)								
	2 BALL		2 LOC		4 BAR		4 LOC		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p
Functional limitation	0.16	0.42	0.19	0.44	0.00	0.00	0.04	0.21	0.059
Physical pain	0.27	0.56	0.31	0.57	0.03	0.18	0.13	0.34	0.055
Psychological discomfort	0.18	0.51	0.16	0.45	0.03	0.18	0.09	0.42	0.384
Physical disability	0.15	0.40	0.12	0.33	0.00	0.00	0.00	0.00	0.067
Psychological disability	0.22	0.57	0.19	0.51	0.00	0.00	0.13	0.46	0.171
Social disability	0.09	0.35	0.09	0.39	0.00	0.00	0.04	0.21	0.524
Handicap	0.16	0.42	0.17	0.38	0.07	0.25	0.22	0.52	0.571
OHIP14	1.24	2.49	1.22	2.23	0.13	0.43	0.65	1.90	0.014
*Kruskal-Wallis test									

TABLE 5 Scores of participants who were grouped according to types of attachment and number of implants to OHIP–14 questionnaire considering both OHIP-SC and OHIP-ADD evaluation methods.

separately, according to the gender factor; According to OHIP-SC, in 2BALL group, in the sub-category of "Psychological Disability", females exhibited statistically higher dissatisfaction (p=0.043). According to OHIP-ADD, in 2LOC group, overall OHIP-14 scores (p=0.010) and the other 3 subcategories (Functional Limitation, Physical Pain, and Physical Disability) females exhibited statistically higher dissatisfaction. According to the age factor, according to both OHIP-SC (p=0.044) and OHIP-ADD (p=0.014), in 2BALL group, in the sub-category of "Handicap", patients under 65 years exhibited statistically higher dissatisfaction.

DISCUSSION

IODs have superior properties compared to conventional prostheses in terms of retention, stability, and function (1, 4, 5, 24). Awad et al. (6), in a multicentric study conducted in three continents, reported that the use of IODs in the mandible increased the quality of life of patients in comparison to the use of conventional prosthesis. The results of the present study also demonstrated that the use of mandibular IODs in the studied population generates high satisfaction rates. Since total edentulism is usually observed in older patients, it is common for IODs to be applied in patients with advanced age. Kuoppalla et al. (28) reported that patients older than 65 years using IODs were more satisfied with their oral health-related quality of life. In the present study, individuals over the age of 65 years constituted almost half of the participants (79; 48%), and they generally welcomed all types of IODs.

Pan et al. (29) reported no gender difference in patient satisfaction with the IODs. Similarly, Mumcu et al. (16) reported that the number of implants and type of attachment used in the IODs did not differ in terms of satisfaction when compared between genders and ages. Besides, Fernandez-Estevan et al. (23) reported that male patients and patients aged over 65 years were more satisfied with their IODs. Similar to Fernandez-Estevan et al. (23), the results of the present study demonstrated that individuals under 65 years were less satisfied, especially in sub-categories of "Handicap" and "Functional Limitation". Additionally, both overall and in several subcategories separately, females were less satisfied with their IODs compared to males. The finding of the present study coincides with the results of Fernandez-Estevan et al. (23), which affirmed that women expect and demand further satisfaction with their prostheses.

IODs may be applied using different numbers of implants and different types of attachment. Kronstrom et al. (30) conducted a research on the clinical practice of 116 prosthodontists from 33 countries and most of them (84%) used two implants, and 13% of the prosthodontists used four implants intending to obtain extended retention. Also, three most commonly preferred attachments were locators, ball attachments, and bar holders. In the present study, the distribution of the types of attachment among the 166 patients was 81 locators (48%), 55 ball attachments (33%), and 30 bar holders (19%); 113 prostheses (68%) were supported by 2 implants, while 53 (32%) by 4 implants.

Ball attachments, which are among the oldest systems, have been used extensively for several years (7, 13, 15, 19, 31). Scherer et al. (13) compared the several different attachments and reported that the ball attachments provided the highest level of retention and stability. Persic et al. (15) advocated that ball attachments are more advantageous compared to the bar holders, and locators. Bilhan et al. (7) reported that the use of two implant-supported ball attachments was a safe and adequate solution. In the present study, all the IODs using ball attachments were supported with two implants. In the overall OHIP-14 scores, the 2BALL group scored similar scores to the 2LOC group which also had two implants.

On the other hand, several researchers have emphasized numerous advantages and encouraged the use of locators. Sadig et al. (14) reported that locators provided the best results in terms of stability and retention. Cicciu et al. (20) reported that the locators were more successful compared to several different attachments. Elsyad et al. (11) reported that ball attachments caused more deformation on the denture compared to the locators. El-Anwar et al. (21) reported that the IODs supported by the locators could have a longer life and require less maintenance. In the present study, locators were supported with either two (2 LOC) and four implants (4 LOC) and higher satisfaction was observed in the 4 LOC group. Besides, in the 2 LOC group, women exhibited higher dissatisfaction compared to men. On the other hand, similar satisfaction scores were observed between 2 BALL and 2 LOC groups.

Another type of attachment that is often preferred is the bar holder. Unlike the locator and ball attachments, the implants are splinted to each other in the bar holders and generally they are not prefabricated, therefore disadvantageous in terms of cost (7, 16, 31-33). In the literature, the use of four implant-supported bar holders in the mandible is prominent, while two or three implant-supported bar holder applications have also been reported. Mumcu et al. (16) reported that four implant-supported bar holders exhibited the highest quality. In the present study, the bar holders supported with four implants increased the satisfaction scores among the patients. Considering a different perspective, given that the females were observed to be more dissatisfied with their IODs according to the results of the present study, 4BAR group was the only group in which women were more satisfied in comparison to men.

Several researchers argue that mandibular IODs should be supported by four implants rather than two in order

to increase retention and patient satisfaction (8, 9, 13, 34, 35). Besides, several studies have argued that two implants are sufficient for mandibular IODs (21, 22, 36). In the present study, the patients who received the IODs supported by four implants exhibited the highest satisfaction rate. The aforementioned result was reflected in the scores obtained using both OHIP evaluation methods, although it was more prominent in the scores of the OHIP-SC method, where the satisfaction rate values were statistically significant ($p=0.014$). On the other hand, based on the high satisfaction values obtained for the IODs in patients in general, the necessity of using 4 implants in each case is controversial. It may not always be necessary to put extra economical and biological effort in placing four implants to support the IODs. Even the two implant-supported mandibular IODs would be able to provide satisfactory results to most patients.

The present study has certain limitations. This study could evaluate neither the maintenance frequency required in the patients with different types of attachment nor the cost of such care for the patients, so it was unable to determine whether these complications were reflected in patients' responses. Information on these factors would provide more consistent results.

CONCLUSION

Within the limits of the present study, it could be stated that, mandibular IODs appear to be associated with a high rate of patient satisfaction, and all the IODs are generally welcome to patients. However, the use of the IODs supported by four implants, especially with bar holders, increased patient satisfaction. There was no difference between locator and ball attachment in terms of patient satisfaction. Also, in general, the satisfaction rates among male patients were higher. Although satisfaction levels were higher in individuals older than 65 years, these results could not be statistically confirmed.

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Informed consent: Informed consent was obtained from all patients for being included in the study.

Data availability statement: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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