Original Article

Evaluation of Tissues Surrounding Implant Supported Fixed Partial Denture with and without Cantilever Extension

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Abstract:

Objective: The aim of this study was to evaluate and compare the status of supporting tissue around implant-supported fixed partial denture with or without cantilever clinically and radiographically during a four-year period.

Materials and Methods: One hundred and fifty nine patients who were treated by 482 implants supported fixed partial prosthesis with and without cantilever after at least four years of treatment, were evaluated. Clinical and radiographic indices of plaque index, probing pocket depth, bleeding index, and marginal bone loss were measured. Collected data were analyzed by Mann-Whitney, Fridman and repeated-measures ANOVA tests using SPSS software.

Results: The overall survival rate of implant supported prosthesis was 95.9% after at least four years of treatment. The success rates of implant supported fixed prosthesis with and without cantilever were 94.6% and 96.8% respectively. Marginal bone loss in the cantilevered fixed prosthesis was significantly more than the second group after two and four years of treatment (P<0.001), however, all the clinical indices were not significantly different.

Conclusion: Considering the guidelines of cantilever prosthesis applications, using the cantilevered fixed partial dentures have a similar and comparable prognosis as the traditional implant-supported fixed prostheses.

Key Words: Dental Prosthesis; Dental Implants; Dental Prosthesis, Implant-Supported

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INTRODUCTION

The health of supporting tissues of dental implants can be endangered by biomechanical factors and bacterial infection. These factors are usually the principal etiology of crestal bone loss around dental implants [1]. In cases, where the remaining bones are unfavorable for implant placement, there would be two ways to face it: bone augmentation, or restoring the edentulous area with cantilever fixed prosthesis. Methods of restoring tissues are very complicated and difficult; meanwhile several studies have described the advantages of rebuilding the function through cantilever fixed prosthesis [2-4] which resulted in high application of cantilever in implant supported fixed prosthesis. Since the impact of a cantilever is similar to a force being exerted by an class I lever [5,6], biomechanical force in implant supported prosthesis might jeopardize the health of its supporting bone [1].

The aim of present study was to evaluate and compare the status of supporting tissue around implant-supported fixed partial denture with or

without cantilever clinically and radiographically during a four-year period.

MATERIALS AND METHODS

This retrospective study assessed 159 patients including 107 men and 52 women in the age range of 23 to 54 year old. All patients were referred to the Department of Implantology, Faculty of Dentistry, Tehran University of Medical Sciences and their treatment plan included implant-supported fixed partial prosthesis with or without cantilevers. Only patients with at least four year history of prosthesis placement were included in this study. The exclusion criteria were: poor oral hygiene, systemic diseases, any illness or syndrome which has effect on oral mucosa, any surgical treatment of soft and hard tissues around the implants after its placement, and prosthesis which were not fabricated according to the guidelines of implant-supported prosthesis. Total of 159 patients who have been treated with 482 ITI and Branemark implants were met the criteria and divided into two groups of cantilevered- and conventional- implant supported prosthesis. The status of supporting tissue was measured using the clinical and radiographic indices as follows:

1. Plaque Index (PI) was measured as described by Silness and Loee [7].
2. Probing Pocket Depth (PPD): The distance between gingival margin and the bottom of gingival sulcus was measured using a millimeter graded Williams style periodontal plastic probe (Hu-Friedy Co, Chicago, USA).
3. Bleeding Index: The Muhlemann index was used to determine this quantity [1].
4. Marginal Bone Loss (MBL) around implants was quantified through intra-oral radiographs by measuring the distance between alveolar crest and implant shoulder.

The clinical indices were measured in six sites: mesiobuccal, buccal, distobuccal, distolingual, lingual, and mesiolingual. All indices were measured at the time of implant loading (zero), one, two, and four years after prosthesis placement.

Collected data were statistically analyzed by repeated-measures ANOVA, Friedmann and Mann-Whitney tests using SPSS software.

RESULTS

Participants were 110 men and 49 women with the mean age of 37.8 (SD=8.6) year old. Amongst 482 implants which were studied, 196 of them supported cantilevered fixed prosthesis (first group) and the second group included 286 implants which were used as conventional implant supported prosthesis.

At the end of the forth year of implant placement, 10 implants of the first group and 9 implants of the second group were failed. The overall success rate was 95.9% after four years of loading with the success rates of 94.6% and 96.8% for the first and second group respec-

Table 1. Measurements of mean probing pocket depth (PPD) and marginal bone loss (MBL) in two groups.

Index	Fixed Prosthesis with cantilever (First group)			Fixed Prosthesis without cantilever (Second group)			P value
	n	mean	SD	n	mean	SD	
PPD 0	166	2.88	1.14	277	2.54	0.96	Ns
PPD 1	164	2.87	1.06	277	2.64	0.95	Ns
PPD 2	160	2.96	1.26	265	2.70	0.98	Ns
PPD 4	178	3.04	1.90	267	2.92	1.60	Ns
MBL 0	156	0.48	0.53	250	0.49	0.43	Ns
MBL 1	154	0.69	0.45	243	0.57	0.48	Ns
MBL 2	160	0.93	0.59	265	0.69	0.51	0.00
MBL 4	150	101	0.66	267	0.80	0.51	0.00

Ns= Not significant

tively.

The mean cantilever length was 8.3 mm (SD=2.4 mm) which 77% of them were located in distal and 23% in the mesial of the implants.

Mean indices of PPD and MBL after the first, second, and forth year of loading in two groups are summarized in Table 1. The mean PPD in the two groups was not significantly different and statistical test only confirmed the negative effect of time on this index.

MBL around implants was not significantly different after one year of loading, however, MBL was higher in the second group after two and four years ($P<0.001$).

Results obtained from plaques and bleeding indices are summarized in Table 2. Neither PI nor bleeding index was significantly different in two groups during the study period.

DISCUSSION

The prognosis of cantilevered fixed partial denture on natural teeth abutments is considered to be poor since its failure rate has been reported 36-40% in a period of 5 to 7 years [8]. There are some anatomical limits for replacing the missing teeth with dental implants, for instance closeness to maxillary sinus and mandibular nerve. Moreover, the great cost of implant treatments might lead to the application of cantilevered fixed prosthesis, however, clinical studies regarding the effect of cantilever on supporting tissues have rarely been carried out.

The cantilever design has a significant influence on stress distribution in implant and its supporting tissues and can lead to unfavorable biomechanical effects around them [9-11]. Furthermore, finite element studies revealed that higher stress concentrations developed in models with cantilever prostheses [12], therefore, in a long term period, could lead to a higher MBL and jeopardize the health of soft and hard tissues supporting implants.

Studies on implants restored with cantilevered fixed prosthesis showed a survival rate between 95.3% to 98.2% [13,14]. In the present study the survival rates of implants supported fixed prosthesis with and without cantilevers were 94.6% and 96.8% respectively. Romeo et al [15] demonstrated a success rate of 96.7% and 96.8% in traditional- and cantilevered-implant supported prosthesis respectively which is similar to the results of current study.

Inspecting the health indices of soft tissue around implants indicate that the PI in groups one and two is zero relating to 58% to 60% points under study regarding four times of investigation.

Similar studies have reported different values for this index. For example, in a study conducted by Gotfredsen and Holm [16], this index was zero related to 90% points at the time of loading, and 76% after four years. Behneke et al [17] reported that the PI in 80% to 84% of the measuring points were zero. Comparing

Table 2. Indices changes of plaque index (PI) and bleeding index (BI) during four years of study period.

Index	Fixed Prosthesis with cantilever		Fixed Prosthesis without cantilever		P value
	n	%	n	%	
PI0	164	64%	277	62%	Ns
PI1	180	60%	270	63%	Ns
PI2	177	59%	268	61%	Ns
PI4	179	59%	265	58%	Ns
BI0	174	59%	270	70%	Ns
BI1	181	59%	261	66%	Ns
BI2	179	59%	269	58%	Ns
BI4	180	60%	271	61%	Ns

Ns= Not significant

the data obtained from the present study and similar studies indicate that patients participated in the present study have poorer oral hygiene.

Bleeding index in the present study was not significantly different in two study groups and it was zero only in 60-70% of measuring points which is comparable to the Behneke et al [17] study. Other similar study did not measure this parameter.

The mean PPD in group one was varied from 2.88 to 3.04 mm during the study period and it was more than 3.5 mm in 29% of measuring points. In group two, the mean PPD was between 2.54 to 2.92 mm while only 10% of measurements were more than 3.5 mm. The mean PPD obtained in present study was similar to levy et al [18] and Behneke et al [13] investigations.

The mean MBL in group one ranged between 0.48 to 1.1 mm, while 35% of the implants had a bone loss more than 1 mm at the end of study. In the second group, MBL varied from 0.49 to 0.8 mm and 15% of implants had a bone loss more than 1 mm. In an investigation conducted by Wennstrom et al [19], bone losses in groups with and without cantilever were 0.49 mm and 0.38 mm respectively. In their assessment, 33% of implants of the cantilevered group had bone loss equal to or more than 1 mm, whereas only 19% of the group without cantilever had the same status [19].

MBLs in the cantilever group were significantly higher than the second group which was restored with traditional fixed prosthesis. Wennstrom et al [19] and Romeo et al [15] have found similar result in their investigations. Since there are evidences to indicate the use of the short implants (8 mm) in distal extension edentulous area have a success rate comparable to 11 mm implants [20], in order to prevent stress concentration in implant's surrounding bone, the use of short implants in distal extension can be suggested.

CONCLUSION

Considering the limitations of this study, the following conclusions can be drawn:

1. By following the guidelines of implant-supported prosthesis, cantilevered prosthesis can have a success rate comparable to conventional implant-supported prosthesis.
2. Using a cantilever design can increase forces delivered to the implants and its surrounding bone, leading to a higher MBL.

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