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Research Article

Comparative Evaluation of Marginal Bone Level Changes in Delayed and Early Implant Placement

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Abstract

Background: The aim of modern dentistry is to restore the patient's health with predictable techniques. Implant-supported prostheses can be used to restore the patient's function, comfort, esthetic, speech, oral health and the integrity of tooth with adjacent hard and soft tissues to some extent. Intraosseous implants can be placed using three different techniques, including the immediate, the early and delayed technique. Due to the longer healing period and formation of bone in the delayed technique, it is hypothesized that the marginal bone around the implants will undergo less resorption compared to the early technique.

Objectives: The aim of this retrospective study was to compare the changes in the levels of marginal bone around implants placed using early and delayed implant placement techniques.

Patients and Methods: In the present retrospective cohort study, 38 implants from the BEGO system were used. These implants were placed in 17 patients in 2 different groups. In group 1, 20 implants were placed early (1 - 2 months after extraction), and in group 2, 18 implants were placed with a delay of more than 4 months after tooth extraction. The marginal bone level was measured on periapical radiographs taken using the parallel technique at three different intervals: at implant placement time, and 6 and 12 months after implant placement. The measurements were made using a digital caliper with an accuracy of 0.01 mm, and the data were analyzed using a repeated-measures ANOVA in association with Mauchly's sphericity test. The statistical significance was set a P < 0.05.

Results: The mean distances between the crestal bone and the implant shoulder in group 1 were 1.01, 1.44, and 1.93 mm at the implant placement time, and at the 6 and 12-month postoperative intervals, respectively. In group 2, these distances were 1.35, 1.20, and 1.41 mm, respectively. There were no significant differences in the marginal bone resorption between the two groups (P > 0.05). **Conclusions:** The amount of crestal bone loss around the implants placed early was greater than that around the implants placed with a delay; however, the differences were not significant.

Keywords: Delayed Implant Placement, Early Implant Placement, Bone Loss

1. Background

The aim of modern dentistry is to restore a patient's health with predictable techniques. Implant-supported prostheses can be used to restore a patient's function, comfort, esthetics, speech, oral health, and the integrity of the teeth, along with the adjacent hard and soft tissues, to some extent (1). The success of the treatment with dental implants depends on the long-term preservation of adjacent soft and hard tissues. Since it is not possible to clinically measure the integrity of the bone, radiographic evaluations can be used to evaluate the bone levels distal and mesial to the implant, in relation to a fixed reference point, in order to estimate the implant stability (2). Intraosseous implants can be placed using three different techniques, including the immediate technique in which the implant is placed immediately after tooth extraction, the early technique, in which the implant is placed after soft tissue healing (i.e. 4 - 8 weeks after tooth extraction), and delayed technique, in which the implant is placed after the healing of the alveolar ridge (i.e. 3 - 6 months after tooth extraction)(3).

Each technique has its advantages and disadvantages. However, both the patients and clinicians usually prefer the early implant placement technique due to the shortening of the treatment period (3). A decrease in the duration and cost of treatment and better acceptance by the patients are some of the advantages of the early implant placement technique, while the formation of adequate bone and the facilitation of flap guidance are some of the

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advantages of the delayed implant placement technique (1). Due to the longer healing period and formation of bone in the delayed technique, it is hypothesized that the marginal bone around the implants will undergo less resorption when compared to the early technique (2). However, there are no definitive studies available in this regard. Therefore, the present study was undertaken to compare the amount of crestal bone loss around the implants with the two early and delayed implant placement techniques.

2. Objectives

The aim of this retrospective study was to compare the changes in the levels of marginal bone around implants placed using early and delayed implant placement techniques.

3. Patients and Methods

The present retrospective cohort study was carried out from 2012 - 2014 on patients referred to the Hamadan faculty of dentistry due to the loss of one or several teeth, or the presence of a tooth or teeth that could not be retained and had to be extracted. A total of 17 patients were selected for each group based on the following inclusion criteria:

1. Absence of systemic conditions contraindicating implant placement.

2. No use of tobacco and alcoholic drinks.

3. Presence of a ridge with adequate height and width so that the subjects in the early group would not need ridge augmentation surgery.

4. Normal occlusion and parafunctional habits.

5. Absence of periodontal disease.

6. Proper oral health (plaque index less than 20%).

7. Placement of all implants in a 2-stage technique and delayed loading.

The subjects in groups 1 and 2 received implants (BEGO SEMADOS® RI, Germany) using the early and delayed techniques, respectively. Of the 38 implants placed, 20 were placed using the early technique and 18 with the delayed technique. All of the treatment procedures were carried out by one skilled surgeon, one prosthodontist, one radiologist, and one laboratory technician with sufficient knowledge and skills, using the standard techniques. All of the implants were loaded 3 - 6 months after implant placement. To determine the amount of bone loss, the distance between the proximal bone level and the shoulder of each implant was measured on a periapical radiograph taken using the parallel technique with the use of a digital caliper (DENTAROOM, England), with the accuracy of 0.01 mm, at three different intervals: immediately after the surgery and at the 6 and 12-month postoperative intervals (Figure 1). All of the measurements were carried out by one operator. To increase the accuracy of the measurements, each measurement was repeated three times, and the mean of the three measurements was used for the statistical analyses. The data were analyzed with a repeatedmeasures ANOVA in association with Mauchly's sphericity test, and statistical significance was set at P < 0.05.

4. Results

In the present study 58 implants were evaluated; 14 and 24 implants were placed in the maxilla and mandible, respectively. Of the 14 implants placed in the maxilla, 7 implants were placed early and 7 were placed using the delayed technique. In the mandible, 13 and 11 implants were placed using the early and delayed techniques, respectively.

According to Table 1, in the maxilla, the distance between the crest of the bone and the implant shoulder increased from the baseline to 12 months after surgery. However, in the mandible, this distance decreased during the 6-month postoperative period, and exhibited an increase at the 12-month postoperative interval.

 Table 1. Comparison of the Means of the Distances Between the Crest of the Bone and the Implant Shoulder at Different Intervals After the Placement of the Implants Using the Delayed Technique in Both Jaws

Jaw	Mean Distance \pm SD ^a	95% CI
Upper		
Surgery time	1.01 ± 0.32	1.67 - 0.35
After 6 months	1.57 ± 0.33	2.25 - 0.88
After 12 months	1.63 ± 0.37	2.38 - 0.87
Lower		
Surgery time	1.70 ± 0.50	2.72 - 0.67
After 6 months	0.84 ± 0.52	1.90 - 0.21
After 12 months	1.19 ± 0.57	2.36 - 0.02

^a From the crest of the bone to the implant shoulder; P = 0.62.

According to Table 2, the early placement of the implants in both jaws resulted in an increase in the mean distance between the crest of the bone and implant shoulder at the 6 and 12-month follow-ups. In addition, at both intervals, the distance was greater in the maxilla when compared to the mandible.

According to Table 3, the mean distances and standard deviations of the distances between the crest of the bone and the implant shoulder, 6 months after implant placement with the early and delayed techniques, were 1.47 \pm



Figure 1. A, Measurement of the distances between the proximal bone level and the shoulder of implant #20 at the distal site. with the use of a digital caliper (DENTAROOM, England) with the accuracy of 0.01 mm; B, measurement of the distances between the proximal bone level and the shoulder of implant #6 at the mesial site with the use of a digital caliper (DENTAROOM, England) with the accuracy of 0.01 mm.

nd the Implant Shoulder at Different Intervals After the Placement of the Implant Ising the Early Technique in Both Jaws			
Jaw	Mean Distance \pm SD ^a	95% CI	
Upper			
Surgery time	1.2 ± 0.25	1.53 - 0.51	
After 6 months	1.60 ± 025	2.13 - 1.07	
After 12 months	2.42 ± 0.28	3.01-1.84	
Lower			
Surgery time	1.00 ± 0.23	1.47 - 0.53	
After 6 months	1.34 ± 0.23	1.82 - 0.85	
After 12 months	1.43±0.26	1.97 - 0.89	

Table 2. Comparison of the Means of the Distances Between the Crest of the Bone

Table 3. Comparison of the Mean Distances Between the Crest of the Bone and the Implant Shoulder at the Different Time Intervals With Both Implant Placement Techniques

Implant Type	Mean Distance \pm SD ^a	95% CI
Delayed		
Surgery time	1.35 ± 0.35	2.08 - 0.63
After 6 months	1.20 ± 0.36	1.95 - 0.45
After 12 months	1.41 ± 0.40	2.24 - 0.58
Early		
Surgery time	1.01 ± 0.17	1.35 - 0.66
After 6 months	1.47 ± 0.17	1.83 - 1.11
After 12 months	1.93 ± 0.19	2.32 - 1.53

^a From the crest of bone to the implant shoulder; P = 0.62.

0.17 and 1.20 \pm 0.36 mm, respectively, with no statistically significant differences. After 12 months, the mean distances in the early and delayed implant techniques were 1.93 \pm 0.19 and 1.41 \pm 0.40 mm, respectively, with no significant differences (P = 0.66).

Table 4 presents the mean distances between the crest of the bone and the implant shoulder at different postoperative intervals in both jaws. At the 6-month interval, the mean distances were 1.58 \pm 0.21 and 1.09 \pm 0.31 mm in the maxilla and mandible, respectively; in addition, the distances were 2.03 \pm 0.23 and 1.31 \pm 0.35 mm in the maxilla and mandible, respectively, at the 12-month interval, indicating a greater distance in the maxilla when compared to

the mandible, but the difference was not statistically sig-

^a From the crest of the bone to the implant shoulder; P = 0.66.

As seen in Table 5, although the statistical analyses showed greater mean distances between the crest of the bone and the implant shoulder in the maxilla and mandible with the early technique, comparing to the delayed technique the differences were not significant.

5. Discussion

nificant (P = 0.30).

The main reasons for the placement of an implant are to replace a lost tooth and preserve the alveolar bone.

Jaw	Mean Distance \pm SD ^a	95% CI
Upper		
Surgery time	1.01 ± 0.20	1.43 - 0.60
After 6 months	1.58 ± 0.21	2.01 - 1.15
After 12 months	2.03 ± 0.23	2.50 - 1.55
Lower		
Surgery time	1.35 ± 0.30	1.98 - 0.72
After 6 months	1.09 ± 0.31	1.74 - 0.44
After 12 months	1.31 ± 0.35	2.03 - 0.59

Table 4. Comparison of the Mean Distances Between the Crest of the Bone and the Implant Shoulder at the Different Postoperative Intervals in Both Jaws

^a From the crest of the bone to the implant shoulder; P = 0.30.

 Table 5. Comparison of the Mean Distances Between the Crest of the Bone and the Implant Shoulder, Without the Time Intervals, With Both Implant Placement Techniques in the Two Jaws

Jaw/Placement	Mean Distance \pm SD ^a	95% CI
Delayed		
Upper	1.40 ± 0.31	2.03 - 0.77
Lower	1.24 ± 0.48	2.22 - 0.26
Early		
Upper	1.68 ± 0.24	2.17 - 1.19
Lower	1.26 ± 0.22	1.71 - 0.81

^a From the crest of the bone to the implant shoulder; P = 0.62.

The pressure and tension exerted on the bone by the implant will stop the process of decreasing bone trabeculation after the extraction of a tooth (4). Six months after tooth extraction, the amount of horizontal and vertical loss of the ridge was 3.8 mm and 1.24 mm, respectively (5). However, the use of an implant will decrease this bone loss. Of course, some bone loss will occur after the placement of the implant. Some of the reasons for the loss of bone around the implants include the elevation of the periosteum during surgery, preparing the bone for implant placement, the presence of a gap between the abutment and the implant body, minor movement of the implant components, bacterial invasion, and stress-related factors. These factors can be evaluated under three categories related to the patient and surgeon, implant, and the time of implant placement after tooth extraction (6). In the present study, attempts were made to match these factors in order to achieve more accurate results.

Based on the results of the present study, the early implant placement technique resulted in an increase of 0.46 mm in the distance between the crest of the bone and the implant shoulder during the first and second 6-month postoperative intervals. This is similar to the results reported by Mish et al., but greater than the values reported by Soydan and Degidi, which might be attributed to the early loading of the implants in the study by Degidi, and the use of panoramic radiographs in the study by Soydan (5-7). Eghbali et al. reported a 1.3-mm bone loss during a 2.5-year period after implant placement (8).

Chang et al. reported that the greatest amount of bone loss occurred during the first 6 months after implant placement, with no definitive changes in the amount of bone loss from 6 to 36 months, which is different from the results of the present study (9). However, another study by Laurell and Lundgren confirmed that the greatest bone loss occurred during the first year after the implant placement (10).

Another method used to place an implant is the delayed implant placement technique. Some of the advantages of this technique are the possibility of the complete healing of the hard and soft tissues, no need for the coronal displacement of the flap, elimination of existing infections in the area under question, and less need for bone grafting (1).

In the present study, the delayed implant placement technique resulted in a mean decrease of 0.15 mm and a mean increase of 0.21 mm in the crestal bone height, 6 and 12 months after implant placement, respectively, compared to the day of surgery, indicating a mean of 0.06 mm of crestal bone loss after one year. This may be attributed to the completion of the hard tissue formation at the time of implant placement. Misch et al. reported a mean bone loss of 0.07 mm during the first year after the implant placement using the delayed technique, consistent with the results of the present study (11). However, Ribeiro et al. reported a mean bone loss of about 0.1 mm in 12 months, which is not consistent with the results of the present study (12). The mean loss of marginal bone during the first year in the study carried out by Kan was 1.6 \pm 1.9 mm, which is higher than that in the present study (13).

With both implant placement techniques, the amount of bone loss in the maxilla was greater than that in the mandible, which might be attributed to the higher bone density in the mandible. However, this difference was not significant, but consistent with the results of different studies on the subject (14-17).

The results of the present study showed that there was more bone loss in the maxilla compared to the mandible. In the early technique, the amount of bone loss was 0.46 mm after 6 months, which increased to 0.92 mm after 12 months. In the delayed technique, the means of the distances between the crest of the bone and implant shoulder immediately after the surgery and at the 6 and 12-month postoperative intervals were 1.35, 1.20, and 1.41 mm, respectively. A comparison of these two techniques showed 0.92 mm of bone loss with the early technique and 0.15 mm with the delayed technique after one year. Based on the results of the present study, it can be concluded that the early implant placement technique resulted in more bone loss when compared to the delayed technique; however, the differences were not significant. Other studies also confirmed the insignificant differences of bone loss in implants placed in early or delayed protocol (3, 18-20).

5.1. Conclusion

In the present study, the changes in the levels of marginal bone in the early implant placement technique were greater than those with the delayed technique. However, since the differences were not significant, the implant placement time should be selected based on the situation.

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Footnotes

Authors' Contribution: Masoumeh Khoshhal developed the original idea and protocol. Fariborz Vafaei and Janet Moradi Haghgoo was participated in this study as a colleague. Faezeh Behgozin and Neda Amiri was associated in writing discussion and this article was written by Banafsheh Poormoradi.

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