DOI: 10.22037/jds.v42i2.44875
Original Article
ISSN 2645-4351

Changes in Alveolar Ridge Dimensions Following Immediate Implantation with and Without Buccal Gap Filling Using Cone-Beam Computed Tomography: A Clinical Trial

Tahereh Sahraei[a], Hasan Semyari[b], Maryam Tehranchi[c], Leila Alibakhsi[d]

[a]Post Graduate Student, Dept. Periodontics, School of Dentistry, Shahed university, Tehran, Iran.
[b]Associate Professor, Dept. Periodontics, School of Dentistry, Shahed university, Tehran, Iran.
[c]Assistant Professor, Dept. Periodontics, School of Dentistry, Shahed university, Tehran, Iran.
[d]Specialist in Oral Radiology, Private Practice, Tehran, Iran.
Correspondence to Maryam Tehranchi (Email: m.tehranchi@shahed.ac.ir).
(*Submitted: 16 March 2024 – Revised version received: 30 May 2024 – Accepted: 3 June 2024– Published online: Spring 2024*)

Abstract

Objectives: This study aimed to assess the changes in alveolar ridge dimensions following immediate implantation with and without buccal gap filling using cone-beam computed tomography (CBCT).
Methods: This prospective randomized clinical trial was conducted on 15 patients (mean age = 44.7 years) with 26 hopeless teeth. The teeth were extracted and immediately replaced with implants. The patients were randomly assigned to two test and control groups (N=13 implants each). In the test group, the gap around the implants was filled with allograft, while the control group did not receive buccal gap filling. CBCT scans were obtained at two days and four months postoperatively. The buccolingual ridge dimensions, buccal plate thickness, and buccal gap distance were measured at the implant platform and 2 and 4 mm apical to it, and changes were analyzed by the mixed-effects model (alpha = 0.05).
Results: In cases with a sound buccal plate having a minimum thickness of one millimeter, the alveolar ridge and buccal plate resorption were the same in the test and control groups.
Conclusion: The results revealed that immediate implantation with and without buccal gap filling did not prevent alveolar ridge and buccal plate resorption
Keywords: Immediate dental implant; Alveolar ridge augmentation; Buccal gap; Cone beam computed tomography

How to cite:
Sahraei T, Semyari H, Tehranchi M, Alibakhsi L. Changes in Alveolar Ridge Dimensions Following Immediate Implantation with and Without Buccal Gap Filling Using Cone-Beam Computerized Tomography: A Clinical Trial. J Dent Sch 2024;42(2):80-88.

Introduction

Tooth extraction, whether single or multiple, leads to changes in the edentulous ridge. During the socket healing process, hard tissue of the socket walls undergoes resorption, and the center of the socket is filled with cancellous bone. Consequently, the overall volume of the socket significantly decreases in both the buccolingual and apico-coronal directions.[1,2]

In the first 25 years following the advent of dental implants, they were only placed in healed extraction sockets in completely edentulous patients following the concept of osseointegration. In 1990, implant placement in the tooth extraction socket was introduced and soon became popular.[3]

The immediate implantation protocol, which is defined as implant placement right after tooth extraction, has several advantages, including decreased number of surgical procedures required, shorter treatment time, skipping the healing period after tooth extraction, preservation of aesthetics and bone height and width, improved quality of life, higher patient satisfaction, and lower morbidity and patient discomfort.[2,4,5] If optimal primary stability is achieved, the success of immediate implantation is comparable to that of conventional (standard) implant placement.[6,7]The standard protocol requires 2 to 3 surgical procedures, further traumatizing the hard and soft tissues.[8,9]

In an animal study, Botticelli et al.[10] noticed that the marginal defects present around immediate implants would heal provided that the periodontium was intact. Accordingly, the proximal bone height is preserved, and crestal width reduction would be limited to the buccal plate.[10]

Evidence is inconclusive regarding the efficacy of bone grafting simultaneous with immediate implantation to prevent or minimize alveolar bone loss.[11] In the International Team for Implantology (ITI) World Symposium, it was concluded that immediate implantation did not prevent horizontal or vertical bone loss after tooth extraction. Also, horizontal bone augmentation following immediate implantation would prevent horizontal bone loss, but vertical resorption of the buccal bone would still continue. Strong evidence suggests that bone augmentation is more successful in immediate implant placement, compared with delayed placement.[12] Nonetheless, a different study demonstrated that applying xenograft to fill the gap after tooth extraction and immediate implantation could not prevent bone loss, with no significant difference noted in buccal bone dimensions between the xenograft and control groups. [13] However, some others discussed that in immediate implant placement and loading, greater bone-implant contact would result in less bone resorption, although the difference between the test and control groups did not show statistical significance.[10] It has also been suggested that applying biomaterial in the extraction socket would result in less horizontal and vertical ridge resorption; however, there is no consensus on the most effective material for this purpose or the predictability of the results.[1]

The available clinical trials concerning the efficacy of graft

materials applied in the gap between dental implants and sockets mostly have a small sample size and have reported conflicting and heterogeneous results.[14] Some studies have reported no significant difference in bone loss between the test and control groups with and without the application of xenografts following immediate implantation, discussing that in cases of atraumatic and flapless surgeries, peri-implant gaps are filled with bone, regardless of their size, and do not require bone grafting or membrane.[1,15,16] Thus, further clinical trials are necessary to assess the treatment's success and bone loss following immediate implantation with and without bone grafting.[2] Considering the existing controversy in this topic, this study aimed to radiographically assess the changes in alveolar ridge dimensions following immediate implantation with and without buccal gap filling using cone-beam computed tomography (CBCT).

Methods

This study was conducted at the Periodontology Department of Shahed University in winter 2021. The study protocol was approved by the university's Ethics Committee (IR.SHAHED.REC.1400.094) and registered in the Iranian Registry of Clinical Trials (IRCT20221218056849N1).

Trial Design

A prospective randomized clinical trial was conducted in which the test group underwent immediate implantation with buccal gap filling, while the control group underwent immediate implantation without buccal gap filling. Changes in bone dimensions were assessed after four months. The results were reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT).

Sample Size

The sample size was calculated to be 13 implants in each group using G Power software version 3.1.9.6, assuming $\alpha = 0.05$, study power of 0.80, and effect size of 1.14.

Participants, Inclusion Criteria, and Settings

Fifteen patients needing 26 dental implants were selected from those presenting to the School of Dentistry at Shahed University and a private clinic using a convenient sampling method. The inclusion criteria were an age of over 18 years, good oral hygiene with no calculus or dental plaque, requiring extraction of a hopeless tooth (due to unrestorable caries, endodontic treatment failure, or crown or root fracture), presence of a sound buccal cortical plate with minimal (< 10%) or no bone loss at the site and the adjacent areas, and optimal apical bone height at the extraction site to ensure optimal primary stability of the implant.[1]

The exclusion criteria included uncontrolled systemic diseases, contraindications for implant placement, heavy smoking, presence of active infection at the surgical site or acute periapical lesions, pregnancy or nursing, periodontal disease of the adjacent teeth, and poor oral hygiene.

Interventions

The current study was conducted in accordance with the Declaration of Helsinki (1964). All patients were enrolled after signing informed consent forms. Through a random coin toss experiment, the patients were assigned to two groups (N=13 implants each): The test group (N=13) involved immediate implantation with bone grafting, and the control group (N=13) involved immediate implantation without buccal gap filling.

After obtaining written informed consent from patients for implant surgery, the patients prophylactically received one gram of amoxycillin or 300 mg of clindamycin one hour prior to the surgical procedure. They also underwent rinsing with 0.2% chlorhexidine mouthwash for 60 seconds. After anesthetic injection, the tooth was atraumatically extracted using a forceps and periotome or surgical scalpel by a flapless technique. The socket walls were examined to ensure the presence of an intact buccal bone plate. Drilling was performed for the placement of a bone-level dental implant, and the implant platform was positioned lingually with a distance from the buccal bone plate and at most one millimeter below the surface of the buccal bone. Primary stability of dental implants was assessed by a surgical ratchet. In the test group, the gap between the implant and socket walls was filled with allograft material (Faravarde Baft Iranian [FDBA], Iran) with 500 to 1000 μm particle size after immersion in saline for five minutes. The type of applied material, allograft, produced by Iranian tissue Products Company, was the most common material used for this purpose in Iran. After its application, a healing abutment with the proper diameter was tightened so that it did not interfere with the opposing teeth. In the control group, no buccal gap filling was performed, and clot formation and preservation were allowed. The healing abutment was then tightened. The patients received postoperative instructions and were prescribed 500 mg of amoxycillin every eight hours, 400 mg of ibuprofen every six hours, and 0.2% chlorhexidine rinse for one week. To prevent bias, all surgical procedures were performed by the same periodontist.

In terms of gender distribution, 38.4% (10 implants) were female patients. Regarding the location of the implants, in the test group, eight implants (61%) were placed in the anterior region between the premolars and five implants (38.5%) in the posterior region of the molars. Furthermore, in the control group, five implants were placed in the anterior region and eight implants were placed in the posterior region.

Tomographic Measurements

CBCT scans with 0.3 mm resolution were obtained after implant placement and after ensuring an intact buccal plate. The buccal plate thickness, the buccal gap distance, and the buccolingual ridge width were measured in the sagittal plane at 0, 2, and 4 mm from the implant platform two days after the surgery. Another CBCT scan was taken after four months, repeating the same measurements. The CBCT scans were taken with a 5 × 5 cm field of view, 110 kV, 9.8 mA, and 1.8 s exposure time.

To correct the orientation of volumetric images, the fixture was first aligned parallel to the vertical line on panoramic-like images. Subsequently, cross-sectional images with the smallest step (0.3 mm step and 0.3 mm thickness) were acquired from the fixture.

At two days, the mid-section was selected for the measurements and the buccal plate thickness, buccal gap distance, and buccolingual ridge width were measured at 0, 2, and 4 mm from the implant platform. The mesial/distal/palatal gap on axial sections at the implant platform level was also measured, if visible (Figure 1).

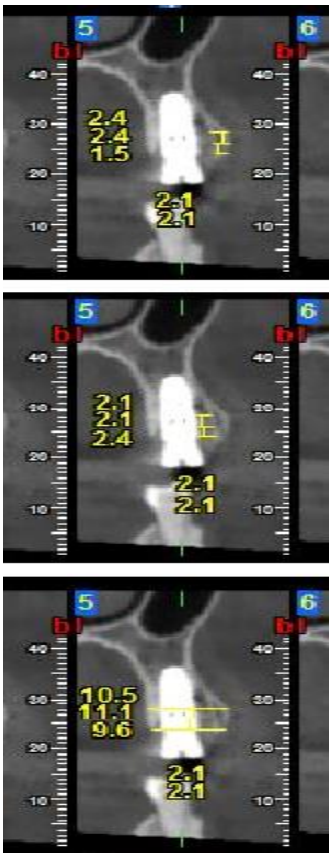

Figure 1: CBCT scans of a representative patient at two days following the surgery

At four months, due to ossification or bone resorption, the buccal plate and gap could not be differentiated on CBCT scans. Thus, the sum of buccal plate and gap was measured and reported. The buccal plate thickness and the buccolingual ridge width were measured at 0, 2, and 4 mm from the implant platform. Additionally, the mesial/distal/palatal gap on the axial section at the implant platform level was also measured, if visible (Figure 2).

All CBCT scans were taken using the same CBCT scanner (EVO; NewTom VGI) and with the same technique. The scans were evaluated by an oral and maxillofacial radiologist. We ensured compliance with all ethical principles related to human studies. Consent was obtained from the patients for CBCT preparation. The CBCTs were taken with a small field of view, and all protective devices, such as lead aprons and thyroid collars, were used during imaging, culminating in a significant reduction in exposure.

To determine the reliability and reproducibility of the findings (intra-rater agreement), the CBCT scans were evaluated again by the same observer two weeks later.

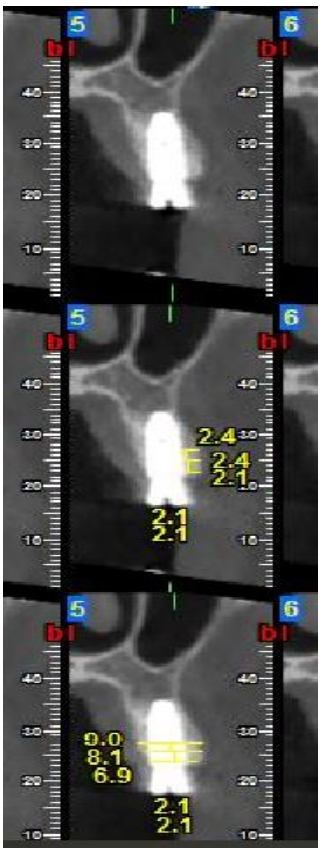

Figure 2: CBCT scans of a representative patient at four months after surgery

Interim Analyses and Stopping Guidelines

No interim analyses were performed, and no stopping guidelines were established.

Randomization

The patients were randomly assigned to the test and control groups on the day of surgery using coin toss random

experiment. For this purpose, of 26 selected hopeless teeth, those with odd numbers were assigned to group 1 (allograft powder), while those with even numbers were assigned to group 2 (control). The surgeon was aware of the groupings.

Statistical Analysis

Data were analyzed using SPSS version 26 (SPSS Inc., IL, USA). To assess the reliability and reproducibility of the findings, the CBCT scans underwent re-measurement two weeks later, and the intraclass correlation coefficient (ICC) was employed for evaluation. The ICC value was calculated as 0.87, with a 95% confidence interval (CI) ranging from 0.351 to 0.952. These results confirm the study's reliability. The Shapiro-Wilk test was used to assess the normality of data distribution, showing normal distribution of data. Also, the Levene's test was applied to analyze the homogeneity of variances, indicating that the assumption of homogeneity of variances was met. Thus, data were analyzed using the mixed-effects model and multiple comparisons with Bonferroni adjustment. The level of significance was set at 0.05.

This study aimed to assess the influence of three factors: The type of bone graft, distance of the implant, and time after implantation on the total thickness of the buccal plate and buccal gap. To achieve these objectives, advanced statistical models capable of concurrently analyzing the effectiveness of these factors are indispensable.

One-way models enable the independent investigation of each component, but they do not facilitate the examination of combined effects, known as interaction effects, on buccolingual thickness.

Given these considerations, the mixed-effects model, commonly referred to as the mixed analysis of variance (ANOVA) model, emerges as a suitable statistical framework for this study. This model allows for the examination of each factor individually while simultaneously assessing their collective impact on the total thickness of the buccal plate and buccal gap. However, it is imperative to note that the model's ability to detect various factors simultaneously necessitates the establishment of specific assumptions, which will be rigorously examined in subsequent sections.

Results

Participant Flow

A total of 26 implants were evaluated in this study. Among them, 38.4% were female. In the test group (N=13), five implants (38.5%) were placed at the molar site, and eight (61.5%) were placed in the anterior (inter-premolar) region. In the control group (N=13), eight implants (61.5%) were placed at the molar site, and five implants (38.5%) were placed in the anterior (inter-premolar) region. Figure 3 presents the CONSORT flow diagram of patient selection and allocation.

Harms

No implants failed during the study.

Subgroup Analyses

Comparison of the sum of buccal plate thickness and buccal gap distance at 0, 2, and 4 mm from the implant platform at two days and four months postoperatively in the test and control groups is provided in Table 1.

Table 1- Table of descriptive findings for the total thickness of buccal plate and buccal gap

Group	Distance (mm)	Time	Mean	Std. deviation	P_value (Normality)
Test=13	0	2 days	3,61	1,59	0.504
		4 months	1.98	1.09	0.249
	2	2 days	3.65	1.29	0.502
		4 months	2.31	1.03	0.481
	4	2 days	3.48	1.38	0.322
		4 months	2.37	0.94	0.214
Control=13	0	2 days	3.30	0.76	0.186
		4 months	1.91	0.89	0.753
	2	2 days	3.31	0.88	0.916
		4 months	1.91	0.72	0.832
	4	2 days	3.81	1.23	0.308
		4 months	2.36	1.24	0.333

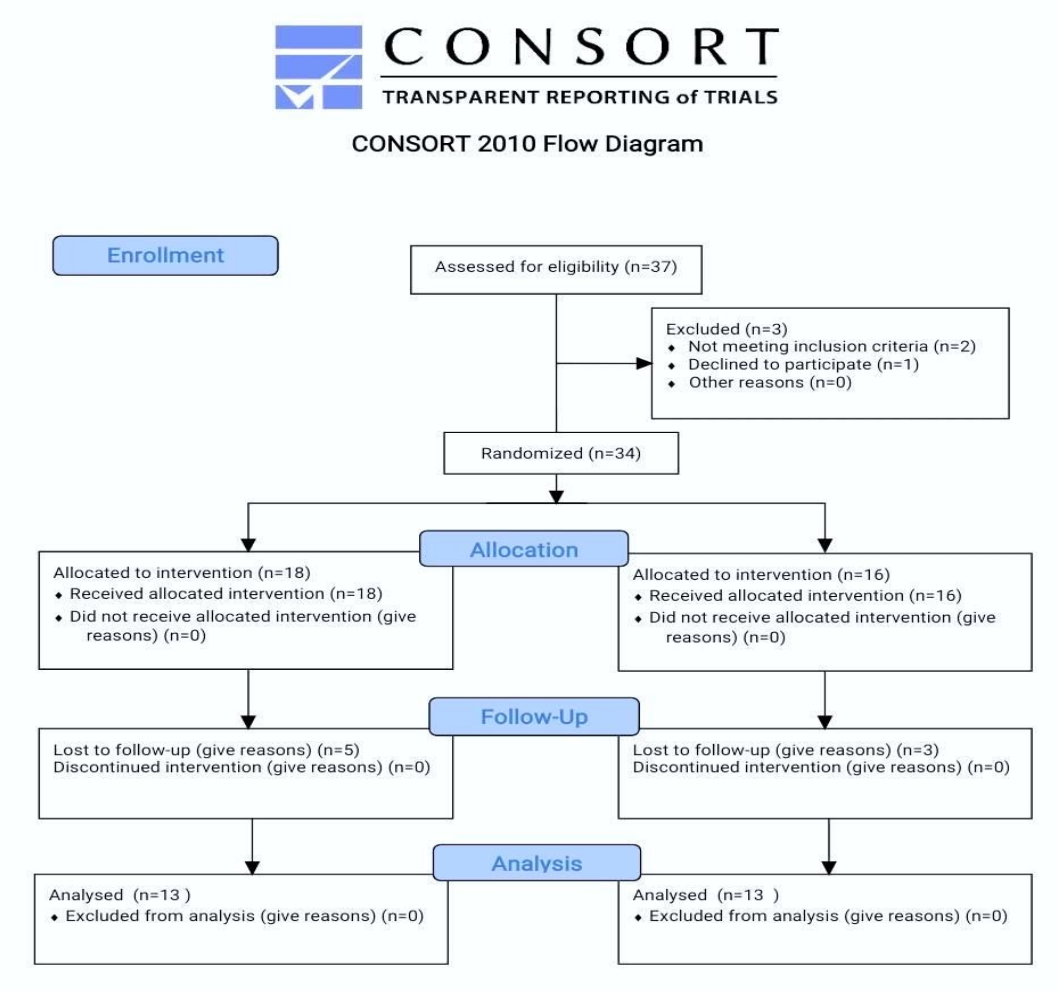

Figure 3: CONSORT flow diagram of patient selection and allocation

Table 2 presents the measures of central dispersion for the sum of buccal plate thickness and buccal gap distance. Assessment of the trend of change in the sum of buccal plate thickness and buccal gap distance over time revealed that the CI with a 95% probability (CI 95%) of thickness was (0.378, 5.938 mm) at two days, decreasing to CI 95% of (0.2, 4.24 mm) at four months in the test group. The CI 95% of thickness was (1.52, 5.44 mm) at two days, decreasing to (0.12, 4 mm) at four months in the control group. The mixed-effects model showed that the interaction effect of time of assessment and group (with and without buccal gap filling) on the sum of buccal plate thickness and buccal gap distance was not significant (P = 0.900). In other words, the trend of change in bone thickness over time was the same in both groups.

Table 2- Descriptive findings table for buccal plate thickness and buccal gap distance in different time intervals and groups

Group	Time	Mean	Std. deviation	CI (95 %)
Test=13	2 days	3.58	1.39	(0.8 , 6.36)
	4 months	2.22	1.01	(0.2 , 4.24)
Control=13	2 days	3.48	0.98	(1.52 , 5.44)
	4 months	2.06	0.97	(0.12 , 4)

-Comparison of the Trend of Change in the Sum of Buccal Plate Thickness and Buccal Gap Distance over Time in the Molar and Inter-Premolar Regions in the Two Groups

Table 3 presents the measures of central dispersion for the change in the sum of buccal plate thickness and buccal gap distance over time in the molar and inter-premolar regions in the two groups. The mixed-effects model showed a similar trend of change in both groups. In other words, the interaction effect of time, region, and group on the sum of buccal plate thickness and buccal gap distance was not significant (P = 0.656).

Table 3- Measures of central dispersion for the change in sum of buccal plate thickness and buccal gap distance over time in molar and inter-premolar regions in the two groups

Group	Region	Time	Mean	Std. deviation
Test	Molar	2 days	4.04	1.79
		4 months	2.42	1.31
	Inter-premolar	2 days	3.29	1.01
		4 months	2.09	0.78
Control	Molar	2 days	3.80	1.16
		4 months	2.17	1.07
	Inter-premolar	2 days	3.15	0.47
		4 months	1.89	0.73

- Comparison of Buccolingual Ridge Width at 0, 2, and 4 mm from the Implant Platform at two days and four months in the Two Groups

Tables 4 and 5 present the measures of central dispersion for the buccolingual ridge width at 0, 2, and 4 mm from the implant platform at two days and four months in the two groups. The mixed effects model showed that the interaction effect of time and group on buccolingual ridge width was not significant (P = 0.282). In other words, the trend of change in buccolingual ridge width was the same in both groups over time.

Table 4- Descriptive findings table for buccolingual ridge thickness

Group	Distance (mm)	Time	Mean	Std. deviation
Test=13	0	2 days	8.95	2.04
		4 months	7.73	1.97
	2	2 days	9.67	1.64
		4 months	8.80	1.74
	4	2 days	10.31	1.64
		4 months	9.25	1.31
Control=13	0	2 days	9.24	1.79
		4 months	8.42	1.65
	2	2 days	10.08	1.70
		4 months	9.08	1.66
	4	2 days	10.25	2.19
		4 months	9.70	2.30

Table 5- Descriptive findings table for buccolingual ridge thickness in different time intervals and groups

Group	Time	Mean	Std. deviation
Test=13	2 days	9.65	1.83
	4 months	8.59	1.77
Control=13	2 days	9.86	1.91
	4 months	9.07	1.92

- Comparison of the Trend of Change in Buccolingual Ridge Width over Time in the Inter-Premolar and the Molar Regions in the Two Groups

Table 6 shows the measures of central dispersion for the change in buccolingual ridge width over time in the inter-premolar and molar regions in the two groups. The mixed-effects model showed that the interaction effect of time, region, and group on buccolingual ridge width was not significant (P = 0.377). In other words, the trend of change in buccolingual ridge thickness in the molar and inter-premolar regions over time was the same in both groups.

- Reduction in the Sum of Buccal Plate Thickness and Buccal Gap Distance at four Months Compared with two Days in the Two Groups

The mean reduction was 1.36 mm (37%) in the test group and 1.41 mm (41%) in the control group at four months compared with two days (Table 7).

Table 6- Measures of central dispersion for the change in buccolingual ridge width over time in the inter-premolar and molar regions in the two groups

Group	Region	Time	Mean	Std. deviation
Test	Molar	2 days	10.60	1.46
		4 months	9.05	1.81
	Inter-premolar	2 days	9.70	1.43
		4 months	7.71	1.63
Control	Molar	2 days	10.64	1.88
		4 months	8.61	1.17
	Inter-premolar	2 days	9.78	1.94
		4 months	7.93	1.23

Table 7- Descriptive findings for the amount and percentage of total reduction of buccal plate and buccal gap from 2 days to 4 months after implantation separately with and without bone grafting

Group		Minimum	Maximum	Mean	Std. deviation
Test=13	Percentage reduction	68٪-	0٪	37٪-	17٪
	Reduction rate	4.50-	0.00	1.36-	0.88
Control=13	Percentage reduction	78٪-	0٪	41٪-	20٪
	Reduction rate	3.00-	0	1.41-	0.75

-Reduction in Buccolingual Ridge Width at four Months Compared with two Days in the Two Groups

The mean reduction was 1.05 mm (11%) in the test group and 0.79 mm (8%) in the control group (Table 8).

Table 8- Descriptive findings for the rate and percentage of buccolingual ridge reduction from 2 days to 4 months after implantation, separately with and without bone grafting

Group		Minimum	Maximum	Mean	Std. deviation
Test=13	Percentage reduction	% -32	%0	% -11	% 0.02
	Reduction rate	-3.90	0	-1.05	0.18
Control=13	Percentage reduction	% -23	%0	% -8	% 0.01
	Reduction rate	-3.00	0	-0.79	0.12

Discussion

This study radiographically assessed the changes in alveolar ridge dimensions following immediate implantation with and without buccal gap filling using CBCT. The results showed equal reduction at the platform and 2 and 4 mm apical to it at four months compared with two days in the test and control groups (P > 0.05). All implants had been well osseointegrated, and there were no failures.

Several clinical trials have shown that filling the peri-implant gap cannot prevent bone resorption and have found no significant difference in buccal bone dimensions between the test and control groups with and without buccal gap filling. [1, 13, 17-21] The same results were obtained in the present study. According to Deporter et al. [15] and Tarnow and Chu [16], if a horizontal gap exists between the implant and buccal bone surface following immediate implantation, and the buccal bone is intact, the gap is usually filled with blood. In the case of flapless surgery and a relatively irregular implant surface, the clot is stabilized, and the gap is filled with new bone without requiring any grafting.[15,16] Atalay et al. [22] placed 110 immediate implants in 72 patients atraumatically without buccal gap filling and reported healing in 105 sites with no further intervention. At the 5-year follow-up, new bone formation and complete bone healing with no damage to the buccal bone plate were noted in all patients. They concluded that a high survival rate of implants and predictable clinical success could be achieved with proper case selection for immediate implantation without buccal gap filling. Their results were consistent with those of the present study. Jacobs et al. [19] used xenograft in their clinical trial and followed up the cases for 10 months. They found no significant difference in the mean crestal buccal bone thickness between the test and control groups and showed bone formation along the buccal bone surface around implants placed in extraction sockets. The CBCT scans taken after 10 months indicated over one millimeter of buccal bone thickness over implants placed in fresh extraction sockets with and without bone grafts. However, different results were reported by Sanz et al. [23], since they showed that immediately placed implants without the application of xenograft experienced a significantly greater bone loss

compared with the control group. The buccal bone thickness was less than one millimeter in their study, which may explain the discrepancy between their results and those of Jacobs et al. [19]. In a 4-month clinical trial, Paknejad et al. [13] assessed the changes in buccal bone dimensions following immediate implantation and filling the gap with xenograft material using CBCT and found no significant difference in the reduction of bone dimensions between the two groups. They concluded that the application of xenograft would not prevent bone loss. [13] Their results were in line with the results of the present research. Similarly, Noelken et al. [20] found no significant difference in intermediate results regarding implant survival and changes in the buccal bone plate, buccolingual width of alveolar bone, probing depth, and implant success between immediate implantation with autogenous bone grafting and biphasic bone graft material, and both groups showed optimal results. The same results were obtained in the present study despite using allograft. It appears that if the buccal bone plate is intact and has a thickness of at least one millimeter, the buccal gap distance is larger than one millimeter, the blood clot is preserved in the buccal gap, and natural bone is formed in the gap along the buccal implant surface, without the need for bone grafting (whether xenograft or allograft). Nonetheless, some others supported the use of bone graft materials simultaneous with immediate implantation and reported that the application of xenograft material would result in lower buccal bone resorption and mid-buccal gingival recession. [23-26] Girlanda et al. [24] supported the use of bovine xenograft for immediate implantation and explained that although the gap is filled spontaneously in both groups of patients with and without xenograft application, xenograft should be preferably used to ensure optimal esthetic results and prevent soft tissue recession. Furthermore, more palatal placement of the implant culminates in the formation of a larger buccal gap, which can enhance bone formation and increase bone-implant contact. [24] If the buccal bone is too thin and the immediate implant is placed too close to the buccal plate, the absence of a buccal gap would lead to buccal bone loss and other complications. Bone graft materials should be necessarily used in such cases to reinforce the buccal plate. [15]

In the present study, the mean reduction in the sum of buccal plate thickness and buccal gap distance was 1.36 mm (37%) in the test group and 1.41 mm (41%) in the control group at four months compared with two days. In Botticelli et al.'s study [10], the buccal prominence at the site of immediate implants decreased by 1.9 mm (56%) at four months. This reduction was 1.1 mm (29%), in the test group and 1.6 mm (38%) in the control group (P=0.02), according to another study by Sanz et al. [23] The same result was observed in the anterior maxilla and in areas with a thinner buccal bone plate.

In the current study, the mean reduction in buccolingual ridge width was 1.05 mm (11%) in the test group and 0.79 mm (8%) in the control group. In Sanz et al.'s study [23], the reduction in buccolingual ridge width was 2.19 mm in the test group and 2.65 mm in the control group (25-30%) after four months; this difference was not significant between the two groups.

In the control group of the present study, the entire cavity was filled with natural bone at the molar site where the implant was placed in the inter-radicular septum, and the placement of the healing abutment could not completely fill the cavity. Overall, the absence of bone graft material did not lead to treatment failure in any previous study, and studies advocating for bone grafting only highlighted better soft tissue outcomes.

Future studies with a larger sample size and different bone graft materials are required. Additionally, split-mouth clinical trials are recommended with longer follow-ups and the use of different membranes to better elucidate this topic.

Conclusion

The present results demonstrate that immediate implantation, with and without buccal gap filling, cannot prevent alveolar ridge and buccal plate resorption. Moreover, the application of allograft in immediate implantation had no significant effect on buccal plate and alveolar ridge resorption.

Acknowledgement: None

Author Contributions: T.S. and H.S. and M.T. and L.A. conceived and designed the analysis Specify; T.S. and H.S. and M.T contribution in more detail; T.S. and H.S. and M.T. collected the data Specify contribution in more detail; T.S. and H.S. and L.A. contributed data or analysis tools Specify contribution in more detail; T.S. and H.S.and L.A. performed the analysis Specify contribution in more detail; T.S. and M.T. wrote the paper Specify contribution in more detail.

Funding: This study was self-funded.

Ethical Approval Code: The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the Shahed University, Dental. Tehran, Iran (ID: IR.SHAHED.REC.1400.094), and registered in the Iranian Registry of Clinical Trials (IRCT20221218056849N1).

Informed Consent Statement: All images of this study have the consent of patients to publish. permission to reproduce material from other sources (if needed).

Data Availability Statement: Data available on request from the authors.

Conflict of Interest: No Conflict of Interest Declared ■

References

1. Bittner N, Planzos L, Volchonok A, Tarnow D, Schulze-Späte U. Evaluation of Horizontal and Vertical Buccal Ridge Dimensional Changes After Immediate Implant Placement and Immediate Temporization With and Without Bone Augmentation Procedures: Short-Term, 1-Year Results. A Randomized Controlled Clinical Trial. Int J Periodontics Restorative Dent. 2020; 40(1):83-93.
2. Arab H, Moeentaghavi A, Sargolzaee N, Radvar M, SarrafShirazi A, Sadeghi R, Shieazadeh F. Evaluation of Effect of Immediate Loading on Clinical Success after Immediate Implantation: A Systematic Review and Meta-Analysis. J Mashhad Dent Sch. 2015;39(3):247-60.
3. Naji BM, Abdelsameaa SS, Alqutaibi AY, Said Ahmed WM. Immediate dental implant placement with a horizontal gap more than two millimetres: a randomized clinical trial. Int J Oral Maxillofac Surg. 2021;50(5):683-90.
4. Han TJ, Pak KB, Klokkevold PR.Esthetic management of difficult cases (minimally invasive opproach). In Caranza's Clinical Periodontology.11th ed. St. Louis: Elsevier; 2011; p: 696-8.
5. Resnik R. Misch's contemporary implant dentistry. 4th Edition. Elsevier Health Sciences; 2020; p830.
6. Becker W, Becker BE. Guided tissue regeneration for implants placed into extraction sockets and for implant dehiscences: surgical techniques and case report. Int J Periodontics Restorative Dent. 1990; 10(5):376-91.
7. Polizzi G, Grunder U, Goené R, Hatano N, Henry P, Jackson WJ, Kawamura K, Renouard F, Rosenberg R, Triplett G, Werbitt M, Lithner B. Immediate and delayed implant placement into extraction sockets: a 5-year report. Clin Implant Dent Relat Res. 2000; 2(2):93-9.
8. Chaushu G, Chaushu S, Tzohar A, Dayan D. Immediate loading of single-tooth implants: immediate versus non-immediate implantation. A clinical report. Int J Oral Maxillofac Implants. 2001;16(2):267-72.
9. Brånemark PI, Adell R, Breine U, Hansson BO, Lindström J, Ohlsson A. Intra-osseous anchorage of dental prostheses. I. Experimental studies. Scand J Plast Reconstr Surg. 1969;3(2):81-100.
10. Botticelli D, Berglundh T, Lindhe J. Hard-tissue alterations following immediate implant placement in extraction sites. J Clin Periodontol. 2004; 31(10):820-8
11. Clementini M, Tiravia L, De Risi V, Vittorini Orgeas G, Mannocci A, de Sanctis M. Dimensional changes after immediate implant placement with or without simultaneous regenerative procedures: a systematic review and meta-analysis. J Clin Periodontol. 2015; 42(7):666-77.
12. Esposito M, Grusovin MG, Kwan S, Worthington HV, Coulthard P. Interventions for replacing missing teeth: bone augmentation techniques for dental implant treatment. Cochrane Database Syst Rev. 2008; 3:CD003607.
13. Paknejad M, Akbari S, Aslroosta H, Panjnoush M, Hajheidary S. Effect of Flapless Immediate Implantation and Filling the Buccal Gap with Xenograft Material on the Buccal Bone Level: A Randomized Clinical Trial. J Dent (Tehran). 2017; 14(6):344-51.
14. Zaki J, Yusuf N, El-Khadem A, Scholten RJPM, Jenniskens K. Efficacy of bone-substitute materials use in immediate dental implant placement: A systematic review and meta-analysis. Clin Implant Dent Relat Res. 2021; 23(4):506-19.
15. Deporter D, Khoshkhounejad AA, Khoshkhounejad N, Ketabi M. A new classification of peri implant gaps based on gap location (A case series of 210 immediate implants). Dent Res J (Isfahan). 2021; 18:29.
16. Tarnow DP, Chu SJ. Human histologic verification of osseointegration of an immediate implant placed into a fresh extraction socket with excessive gap distance without primary flap closure, graft, or membrane: a case report. Int J Periodontics Restorative Dent. 2011; 31(5):515-21.
17. Kan JY, Rungcharassaeng K, Lozada J. Immediate placement and provisionalization of maxillary anterior single implants: 1-year prospective study. Int J Oral Maxillofac Implants. 2003; 18(1):31-9.
18. Grassi FR, Grassi R, Rapone B, Alemanno G, Balena A, Kalemaj Z. Dimensional changes of buccal bone plate in immediate implants inserted through open flap, open flap and bone grafting and flapless techniques: A cone-beam computed tomography randomized controlled clinical trial. Clin Oral Implants Res. 2019; 30(12):1155-64.
19. Jacobs BP, Zadeh HH, De Kok I, Cooper L. A Randomized Controlled Trial Evaluating Grafting the Facial Gap at Immediately Placed Implants. Int J Periodontics Restorative Dent. 2020; 40(3):383-92.
20. Noelken R, Pausch T, Wagner W, Al-Nawas B. Peri-implant defect grafting with autogenous bone or bone graft material in immediate implant placement in molar extraction sites-1- to 3-year results of a prospective randomized study. Clin Oral Implants Res. 2020; 31(11):1138-48.
21. Mohamed HHB, Serag Eldien AM, Zahran A. Augmentation versus No Augmentation for Immediate Postextraction Implants. Int J Dent. 2018; 2018:5209108.
22. Atalay B, Öncü B, Emes Y, Bultan Ö, Aybar B, Yalçin S. Immediate implant placement without bone grafting: a retrospective study of 110 cases with 5 years of follow-up. Implant Dent. 2013; 22(4):360-5.
23. Sanz M, Lindhe J, Alcaraz J, Sanz-Sanchez I, Cecchinato D. The effect of placing a bone replacement graft in the gap at immediately placed implants: a randomized clinical trial. Clin Oral Implants Res. 2017; 28(8):902-10.
24. Girlanda FF, Feng HS, Corrêa MG, Casati MZ, Pimentel SP, Ribeiro FV, Cirano FR. Deproteinized bovine bone derived with collagen improves soft and bone tissue outcomes in flapless immediate implant approach and immediate provisionalization: a randomized clinical trial. Clin Oral Investig. 2019; 23(10):3885-93.
25. Seyssens L, Eeckhout C, Cosyn J. Immediate implant placement with or without socket grafting: A systematic review and meta-analysis. Clin Implant Dent Relat Res. 2022; 24(3):339-51.
26. Daif ET. Effect of a multiporous beta-tricalicum phosphate on bone density around dental implants inserted into fresh extraction sockets. J Oral Implantol. 2013; 39(3):339-44.