

# Radiographic Evaluation of Marginal Bone Loss Following Immediate and Delayed Implantation

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## Abstract

**Background and Aim:** Intraosseous implants can be placed using three different techniques: immediate, early, and delayed. The aim of this study was to compare the changes in the marginal bone level around implants after immediate and delayed implant placement.

**Materials and Methods:** In the present prospective cohort study, 26 implants were placed in 26 patients divided into two groups. In group 1, 13 implants were placed immediately, while in group 2, 13 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 implant placement time and 6 and 12 months after implantation. The measurements were made using a digital caliper with an accuracy of 0.01 mm, and the data were analyzed using repeated-measures analysis of variance (ANOVA) and Mauchly's sphericity test. The statistical significance was set at  $P < 0.05$ .

**Results:** The mean distances between the crestal bone and the implant shoulder in group 1 were 1.12 mm, 1.48 mm, and 1.77 mm at implant placement time and 6 and 12 months postoperatively, respectively. In group 2, these distances were 1.26 mm, 1.46 mm, and 1.71 mm, respectively. There were no significant differences in marginal bone resorption between the two groups ( $P > 0.05$ ).

**Conclusion:** There was no significant difference in crestal bone loss around implants placed with immediate and delayed techniques.

**Key Words:** Endosseous Dental Implantation, Immediate Dental Implant Loading, Alveolar Bone Loss

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## Introduction

The goal of modern dentistry is to restore patient health through the use of predictable techniques. Nowadays, implant-supported prostheses are widely used to restore function, aesthetics, comfort, health, and dental integrity [1]. Intraosseous implants can be placed using three different techniques: immediate, early, and delayed [2]. In the immediate method, the implant is placed

in the socket immediately after tooth extraction. In the delayed method, the implant is placed in the socket after soft tissue healing (4 to 8 weeks after tooth extraction), and finally, in the delayed or the usual method, an implant is placed after alveolar bone healing (3 to 6 months after tooth extraction) [2].

Each technique has its own advantages and disadvantages. However, patients and clinicians

generally prefer to use a technique that shortens the treatment period [2]. The advantages of the immediate technique include alveolar bone preservation, ideal axial orientation of the implant in accordance with tooth socket as a reference, elimination of 3-6-month waiting periods, less surgical sessions, and shorter toothless period [3]. On the other hand, there is a potential risk of inconsistency between the wall of tooth socket and the implant in the immediate method, which will have a negative effect on the initial stability and hard and soft tissue support of the implant, leading to fibrous tissue formation [3]. Some clinicians believe that immediate implant placement prevents bone resorption and therefore reduces the need for bone grafting and augmentation processes [4]. However, others have doubts about these advantages and believe that implant placement simultaneous with tooth extraction leads to more surgical complications and less acceptable aesthetics [5]. On the other hand, due to longer periods of healing and bone formation in the delayed methods, it is assumed that marginal bone resorption around implants is less than that in the immediate method [5]. There are many studies in this field but with different conclusions based on their case selection, timing, outcome, and studied areas. Crespi et al [6] and Grunder [7], in separate studies, showed that there is no difference between the two techniques in the anterior dental region. However, Schropp et al [8] concluded that new bone formation occurs associated with immediately placed implants in extraction sockets. Therefore, in this study, we aimed to compare the rate of crestal bone loss around implants placed using immediate and delayed methods. The success of dental implantation depends on the preservation of adjacent hard and soft tissues [8]. Radiographic evaluation can be used to assess the mesial and distal peri-implant bone levels relative to a reference point [9].

### Materials and Methods

This prospective study was conducted on patients referring to the School of Dentistry of Hamadan University of Medical Sciences, Hamadan, Iran, during 2016-2017. All patients were aware of the study method and after being informed of the potential problems and risks, they signed an

informed consent form. Patients were selected based on the following criteria:

#### *Inclusion criteria:*

The presence of a hopeless tooth in the anterior or premolar region, the presence of an adequate mesiodistal space (6.5 mm or more) for placement of an implant with 3.5-mm or maximum possible diameter based on the anatomy of the area, the presence of a bundle of keratinized mucosa around the hopeless tooth, the presence of adjacent teeth, either intact or restored using a proper and functional restoration with no pathological periradicular lesions, proper oral hygiene (plaque index below 20%), and normal occlusion [5,10-12].

#### *Exclusion criteria:*

Patients at an early (growing) age, any systemic disease that prevents minor surgeries, psychosis, consumption of tobacco and alcoholic beverages, history of addiction, consumption of anticancer and corticosteroid drugs, smoking, parafunctional habits, periodontal diseases, pathology or periapical and periodontal lesions at the extraction site, and poor bone quality and quantity [5,10].

Finally, 26 eligible patients were selected [12]. All of these patients were candidates for receiving an implant in the anterior or premolar region. Fourteen implants were placed in the mandible and 12 implants were placed in the maxilla. Seven implants in the mandible and six implants in the maxilla were placed immediately, and the rest were placed using the delayed methods.

Periapical and cone-beam computed tomography (CBCT) radiographs were taken in order to evaluate the bone quality and quantity as well as the position and orientation of the implants. After radiographic evaluation, the implants with appropriate sizes were used.

It should be noted that all treatment procedures were conducted based on standard techniques and were performed by a skilled surgeon, a prosthodontist, a radiologist, and an experienced laboratory technician with sufficient knowledge and skills.

#### *Surgical procedures:*

In the immediate implantation group, after the induction of local anesthesia, the teeth were loosened using an elevator and extracted by a pair of forceps in an attempt to preserve the bony

socket walls. After debridement and washing, dental cavities were carefully examined regarding fractures in the walls. If there were any defects in the walls interfering with immediate implantation, the patient was replaced with a patient from the delayed implantation group. A periosteal flap was raised through a crestal incision at the mesial and distal aspects of the socket [13]. The depth and the mesiodistal and buccolingual dimensions of the socket were measured using a caliper, and implants with an appropriate diameter and platform size best fitted to the socket walls were selected. In this study, SIC implants (SICvantage® max, Switzerland) were used. Finally, consecutive drillings were performed such that the corresponding cover screw was at the same level as the adjacent bone. Ultimately, the primary closure of the region by soft tissue was performed, and the area was sutured (Silk 4-0, SUPASIL, SUPA Medical Devices Co., Tehran, Iran).

In the delayed implantation group, after the induction of anesthesia, a mucoperiosteal flap was elevated through a crestal incision, which was located almost 2-3 mm lingual to the alveolar crest and extended to the sulcus of the adjacent teeth through an intrasulcular incision; this cut prevents the formation of scar tissue at the alveolar crest. The buccolingual and mesiodistal locations of the implant are somewhat determined by the alveolar morphology. Pilot, intermediate, and final drills were performed, and finally, the cover screw was closed such that it was at the same level with the adjacent bone. The primary closure by soft tissue was done, and the area was sutured.

Antibiotic prophylaxis (Amoxicillin 500 mg; Farabi Pharmaceutical Co., Isfahan, Iran) was performed for all patients one hour before surgery, which was continued for one week twice a day. Postoperative analgesics and necessary health instructions were prescribed for the patients. The sutures were removed after one week. Four months after implant placement, the healing abutment was closed with a mid-crestal incision [13]. After soft tissue healing period (4 to 6 weeks), impression taking and construction of crowns began [14]. Afterward, the crowns were adjusted intraorally and cemented. The implants were loaded 6 months postoperatively.

To evaluate the rate of bone resorption, the distance

between the proximal bone level and the shoulder of each implant was measured on a periapical radiograph taken using the long-cone parallel technique and with a specific custom-made bite block under standard exposure conditions. The radiographs were evaluated at  $\times 20$  magnification in digital format using an image analysis software for clinical radiography (Sorriso® Image; Dental Trey s.r.l., Fiumana di Predappio, Italy) by a single operator immediately after surgery, at loading time (6 months after surgery), and 6 months after loading (12 months after surgery).

All measurements were performed by an experienced radiologist. Measurements were performed at the mesial and distal regions, and the mean of these two was considered as the resorption rate. In order to increase the accuracy, each measurement was repeated three times, and the mean of the measurements was used for statistical analysis. Data were analyzed by repeated measures analysis of variance (ANOVA) and Mauchly's sphericity test. The significance level was set at  $P < 0.05$ .

## Results

According to Table 1, immediate and delayed implantations in both jaws resulted in an increase in the mean distance between the crestal bone and the implant shoulder at 6- and 12-month intervals. In addition, in both periods, this distance in the immediate method in the maxilla was more than that in the mandible; however, in the delayed method, the mandible showed more average resorption than the maxilla.

Table 2 shows the mean distance between the crestal bone and the implant shoulder in the jaws at the mentioned time intervals. After 6 months, the mean distances in the mandible and the maxilla were  $1.39 \pm 0.24$  mm and  $1.51 \pm 0.24$  mm, respectively. After 12 months, these distances were  $1.55 \pm 0.24$  mm and  $1.78 \pm 0.24$  mm in the mandible and the maxilla, respectively. However, there was no significant difference between the two jaws ( $P > 0.001$ ).

According to Table 3, although after 12 months, the average distance in the delayed implantation group was less compared to the immediate implantation group, there was no significant difference between the two groups ( $P > 0.001$ ).

**Table 1.** Comparison of the mean distance (mm) between the crestal bone and the implant shoulder at different time intervals after immediate and delayed implant placement in the maxilla and the mandible

Implant placement technique	Jaw	N	Measurement time (months)	Mean±SD	CI	
					Lower bound	Upper bound
Immediate (n=13)	Mandible	7	0	1.03±0.31	0.85	1.2
			6	1.34±0.34	1.15	1.53
			12	1.57±0.35	1.37	1.76
	Maxilla	6	0	1.22±0.31	1.03	1.4
			6	1.61±0.34	1.41	1.82
			12	2.01±0.35	1.8	2.22
Delayed (n=13)	Mandible	7	0	1.29±0.31	1.12	1.47
			6	1.43±0.43	1.24	1.62
			12	1.54±0.35	1.35	1.73
	Maxilla	6	0	1.23±0.31	1.04	1.42
			6	1.41±0.34	1.02	1.61
			12	1.55±0.35	1.34	1.76

SD=Standard Deviation, CI=Confidence Interval

**Table 2.** Comparison of the mean distance (mm) between the crestal bone and the implant shoulder at different time intervals in the maxilla and the mandible

Jaw	N	Measurement time (months)	Mean±SD	CI		P-value
				Lower bound	Upper bound	
Mandible	14	0	1.16±0.22	1.04	1.28	0.167
		6	1.39±0.24	1.25	1.52	
		12	1.55±0.24	1.42	1.69	
Maxilla	12	0	1.22±0.22	1.09	1.36	
		6	1.51±0.24	1.36	1.66	
		12	1.78±0.24	1.63	1.93	

SD=Standard Deviation, CI=Confidence Interval

**Table 3.** Comparison of the mean distance (mm) between the crestal bone and the implant shoulder at different time intervals after immediate and delayed implant placement

Implant placement technique	N	Measurement time (months)	Mean±SD	CI		P-value
				Lower bound	Upper bound	
Immediate	13	0	1.12±0.22	0.99	1.25	0.157
		6	1.48±0.24	1.34	1.62	
		12	1.77±0.24	1.62	1.92	
Delayed	13	0	1.26±0.22	1.13	1.39	
		6	1.46±0.24	1.31	1.61	
		12	1.71±0.24	1.57	1.85	

SD=Standard Deviation, CI=Confidence Interval

## Discussion

The survival rate of single dental implants has been exponentially improved [15,16]; however, the outcome of this treatment is dependent on aesthetics, hard and soft tissue changes, patient satisfaction, and related complications [15]. With the advancement of implant dentistry, more advanced therapeutic strategies have been developed for implant placement and loading [16]. This study was conducted to evaluate and compare two implant placement techniques. The first method comprised immediate implant placement in the fresh socket of an extracted tooth. In the second method, the implant was placed in a healed dental socket [17].

The rates of horizontal and vertical resorptions of the alveolar ridge six months after tooth extraction are 3.8 mm and 1.24 mm, respectively [18]. However, implant placement reduces this rate of resorption. The pressure and stretching exerted on the bone through the implant end the process of reducing trabeculation after tooth extraction [19]. Of course, some resorption will occur after implantation. Some of the reasons for this bone resorption include lifting the periosteum during surgery, bone preparation for implant placement, a gap at the implant-abutment interface, minor movements of the implant components, bacterial invasion, and stress-related factors [20]. These factors can be evaluated in three categories related to patient, surgeon, and implant as well as the time of implant placement after tooth extraction [20]. This study attempts to coordinate these factors in order to achieve more accurate results.

In this study, evaluation of crestal bone level on periapical radiographs [19] indicated that bone resorption occurs at the proximal surfaces of implants in both groups. The average bone resorption was 1.77 mm in the immediate implantation group and 1.71 mm in the delayed implantation group from the time of the placement of the crown to 12 months later, which did not differ significantly. These results were consistent with the results reported by Grunder et al [18] who studied bone resorption in immediate and delayed implantation groups at the same time periods and found that the average bone resorption in the proximal region is about 0.8 mm. These results were also consistent with the results reported by

Block et al [19] who compared immediate and delayed implantation methods along with immediate temporary restoration and found that bone resorption was similar in the two methods. The study by Barone et al [20] in this field showed similar results. Sunitha et al [21] showed that lifting the flap could lead to increased crestal bone loss during the healing period. The benchmark of success of implant therapy, which was reported at the first European periodontal conference, is bone resorption less than 1.5 mm in the first year after the placement of the prosthesis [22-24]. In the present study, the average bone resorptions in both groups are higher than the above-mentioned rate, which can be attributed to the type of implant system (SIC) used with high technical sensitivity during surgery. Of course, the main purpose of this study was to compare the two techniques, and the numerical value of the resorption is less important. Nonetheless, it is suggested that other implant systems be used in a more favorable clinical setting in future studies.

The limitations of this study include small number of samples, the placement of implants without any special arrangement in the anterior or posterior region, impossibility of using the contralateral site for comparison, the lack of usage of implant stability testing, evaluation of the resorption rate using radiographs and the probability of radiographic errors, and evaluation of bone loss only at the interproximal regions

## Conclusion

According to the results of the present study, there was no significant difference in crestal bone loss around implants placed with immediate and delayed techniques.

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## References

1. Misch CE. Dental Implant Prosthetics. St. Louis, MO: Mosby, 2015:1053-65.
2. Annibali S, Bignozzi I, Iacovazzi L, La Monaca G, Cristalli MP. Immediate, early, and late implant placement in first-molar sites: a retrospective case series. *Int J Oral Maxillofac Implants*. 2011 Sep-

- Oct;26(5):1108-22.
3. Barzilay I, Graser GN, Iranpour B, Natiella JR. Immediate implantation of a pure titanium implant into an extraction socket: report of a pilot procedure. *Int J Oral Maxillofac Implants*. 1991 Fall; 6(3):277-84.
  4. Barone A, Marconcini S, Giammarinaro E, Mijiritsky E, Gelpi F, Covani U. Clinical Outcomes of Implants Placed in Extraction Sockets and Immediately Restored: A 7-Year Single-Cohort Prospective Study. *Clin Implant Dent Relat Res*. 2016 Dec;18(6):1103-1112.
  5. Tonetti MS, Cortellini P, Graziani F, Cairo F, Lang NP, Abundo R, et al. Immediate versus delayed implant placement after anterior single tooth extraction: the timing randomized controlled clinical trial. *J Clin Periodontol*. 2017 Feb; 44(2): 215-224.
  6. Crespi R, Capparé P, Crespi G, Lo Giudice G, Gastaldi G, Gherlone E. Immediate Implant Placement in Sockets with Asymptomatic Apical Periodontitis. *Clin Implant Dent Relat Res*. 2017 Feb;19(1):20-27.
  7. Grunder U. Immediate functional loading of immediate implants in edentulous arches: two-year results. *Int J Periodontics Restorative Dent*. 2001 Dec;21(6):545-51.
  8. Schropp L, Kostopoulos L, Wenzel A. Bone Healing Following Immediate Versus Delayed Placement of Titanium Implants into Extraction Sockets: A Prospective Clinical Study. *Int J Oral Maxillofac Implants*. 2003 Mar-Apr;18(2):189-99.
  9. Shahidi P, Jacobson Z, Dibart S, Pourati J, Nunn ME, Barouch K, et al. Efficacy of a new papilla generation technique in implant dentistry: a preliminary study. *Int J Oral Maxillofac Implants*. 2008 Sep-Oct;23(5):926-34.
  10. Orenstein IH, Petrazzuolo V, Morris HF, Ochi S. Variables affecting survival of single-tooth hydroxyapatite-coated implants in anterior maxillae at 3 years. *Ann Periodontol*. 2000 Dec; 5 (1):68-78.
  11. Khoshhal M, Vafaei F, Poormoradi B, Moradi Haghgoo J, Behgozin F, Amiri N, et al. Comparative evaluation of marginal bone level change in delayed and early implant placement. *Avicenna J Dent Res*. 2016 Mar;8(1):e24673.
  12. Taylor RC, McGlumphy EA, Tatakis DN, Beck FM. Radiographic and clinical evaluation of single-tooth BioloK implants: A 5-year study. *Int J Oral Maxillofac Implants*. 2004 Nov-Dec;19(6):849-54.
  13. Rosenstiel SF, Land M. *Contemporary Fixed Prosthodontics*. St. Louis, MO: Mosby, 2016:334.
  14. Romeo E, Lops D, Rossi A, Storelli S, Rozza R, Chiapasco M. Surgical and prosthetic management of interproximal region with single-implant restorations: 1-year prospective study. *J Periodontol*. 2008 Jun;79(6):1048-55.
  15. Pikner SS, Grondahl K. Radiographic analyses of "advanced" marginal bone loss around Brånemark dental implants. *Clin Implant Dent Relat Res*. 2009 Jun;11(2):120-33.
  16. Soydan SS, Cubuk S, Oguz Y, Uckan S. Are success and survival rates of early implant placement higher than immediate implant placement? *Int J Oral Maxillofac Surg*. 2013 Apr; 42 (4):511-5.
  17. Sasi Kumar PK, Ravikumar A, Elavarasu S, Kumaran T, Murugan B. Clinical and Radiographic Evaluation of Immediate and Delayed Single-tooth Implant Placement: An 18-month Follow-up Study. *J Periodontol Implant Dent*. 2013;5(2):41-54.
  18. Grunder U, Polizzi G, Goené R, Hatano N, Henry P, Jackson WJ, et al. A 3-year prospective multicenter follow-up report on the immediate and delayed-immediate placement of implants. *Int J Oral Maxillofac Implants*. 1999 Mar-Apr;14(2):210-6.
  19. Block MS, Mercante DE, Lirette D, Mohamed W, Ryser M, Castellon P. Prospective evaluation of immediate and delayed provisional single tooth restorations. *J Oral Maxillofac Surg*. 2009 Nov; 67 (11 Suppl):89-107.
  20. Barone A, Toti P, Quaranta A, Derchi G, Govani U. The Clinical Outcomes of Immediate Versus Delayed Restoration Procedures on Immediate Implants: A Comparative Cohort Study for Single-Tooth Replacement. *Clin Implant Dent Relat Res*. 2015 Dec;17(6):1114-26.
  21. Sunitha RV, Ramakrishnan T, Kumar S, Emmadi P. Soft tissue preservation and crestal bone loss around single-tooth implants. *J Oral Implantol*. 2008;34(4):223-9.
  22. Albrektsson T, Dahl E, Enbom L, Engevall S, Engquist B, Eriksson AR, et al. Osseointegrated oral implants. A Swedish multicenter study of

8139 consecutively inserted Nobelpharma implants. J Periodontol. 1988 May;59(5):287-96.  
23. Agliardi E, Panigatti S, Clerico M, Villa C, Malo P. Immediate rehabilitation of the edentulous jaws with full fixed prostheses supported by four implants: interim results of a single cohort

prospective study. Clin Oral Implants Res. 2010 May;21(5):459-65.  
24. Degidi M, Piattelli A, Gehrke P, Felice P, Carinci F. Five-year outcome of 111 immediate nonfunctional single restorations. J Oral Implantol. 2006;32(6):277-85.