DOI: http://doi.org/10.54617/adoklinikbilimler.1331015

Original Research Article

Evaluation of Implant Survival in Grafted and Ungrafted Bone: A 5-Year Follow-Up Study

Greftlenmiş ve Greftlenmemiş Kemikte İmplant Sağkalımının Değerlendirilmesi: 5 Yıllık Takip Çalışması

Levent Ciğerim[1], Serap Keskin Tunç[1], Zeynep Dilan Orhan[2], Abdurrahman Galayene[3], Mohammad Alsmadi[3], Nazlı Hilal Kahraman[3]

ABSTRACT

Aim: This study aimed to evaluate the success rates of dental implants placed in native bone to those placed in grafted bone.

Materials and Method: A retrospective evaluation of patients who underwent dental implant procedures between 2016 and 2018 and who had a 5-year follow-up. These data included the patient's demographic information, the number and regions of implants, failed implants, grafting type, technique and healing time. Two groups were used: Group 1, the study group, consists of implants made in the grafted bone, and Group 2, the control group, consists of implants made in the ungrafted bone.

Results: The placement of 3170 implants was in 890 patients. The findings indicate that a majority of the implants, specifically 88% (n=2791), were not subjected to grafting procedures. However, the survival rate of the implants was 98.8%. The rate of implant survival was higher in the ungrafted bone compared to the grafted bone (p=0.039; p<0.05).

Conclusion: The survival rate of implants was higher in ungrafted bone. The findings indicate that augmenting of the width of the grafted bone before or during implant surgery is a viable procedure, as evidenced by the implant survival rate of 97.62% .

Keywords: Failed implant; Grafted bone; Implant survival

ÖZET

Amaç: Bu çalışmada doğal kemiğe yerleştirilen dental implantların greftlenmiş kemiğe yerleştirilenlere göre başarı oranlarının değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntem: Bu çalışma, Ocak 2016-2018 tarihleri arasında dental implant uygulanan ve 5 yıllık takibi olan hasta kayıtlarının retrospektif ve gözlemsel olarak değerlendirilmesidir. Bu veriler, hastanın demografik bilgilerini, implantların sayısı ve bölgelerini, başarısız (fail) implantları, greft yapılıp yapılmadığını ve yapıldıysa greft tipi, tekniği ve iyileşme süresini içermektedir. Çalışmada kullanılan iki implant grubu bulunmaktadır: Grup 1, çalışma grubu, greftlenmiş kemikte yapılan implantlar; Grup 2, kontrol grubu, greftlenmemiş kemikte yapılan implantlar.

Bulgular: Çalışma, 890 hastadan oluşan bir kohortta 3170 implantın yerleştirilmesini içermektedir. Çalışma bulguları, implantların çoğunluğunun (%88'inin; n=2791) greftleme prosedürlerine tabi tutulmadığını göstermektedir. Bununla birlikte, implantların genel sağkalım oranının %98.8 olduğu kaydedilmiştir. İstatistiksel analiz, implant sağkalım oranının greftlenmemiş kemikte greftlenmiş kemiğe göre anlamlı derecede yüksek olduğunu ortaya koymaktadır (p=0.039; p<0.05).

Sonuç: İmplantların sağkalım oranı, greftlenmemiş kemikte greftlenmiş kemiğe kıyasla nispeten daha yüksekti. Bulgular, implant cerrahisi öncesinde veya sırasında greftleme yaparak kemik genişliğini artırmanın, 5 yıllık bir takip süresinden sonra %97.62'lik implant sağkalım oranınından görüldüğü üzere, kemik genişliğinin yetersiz olduğu durumlar için geçerli bir prosedür olduğunu göstermektedir.

Anahtar Kelimeler: Fail implant; Greftlenmiş kemik; İmplant sağkalımı

Makale gönderiliş tarihi: 22.07.2023; Yayına kabul tarihi: 27.09.2023

İletişim: Dt. Abdurrahman Galayene
Van Yüzüncü Yıl University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, Van, Turkey Post Code: 65080
E-Posta: dentist.a.gh@gmail.com
[1] Doç. Dr., Van Yüzüncü Yıl University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, Van, Turkey Post
[2] Dr. Öğr. Üyesi., Van Yüzüncü Yıl University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, Van, Turkey Post
[3] Dt., Van Yüzüncü Yıl University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, Van, Turkey Post

INTRODUCTION

Dental implants are popular because, unlike other treatment alternatives, they preserve adjacent tooth and bone structure. Moreover, implant therapy for edentulous and partially edentulous patients is believed to enhance masticatory function and quality of life. As a consequence, dental implants are gaining popularity as a method for replacing missing teeth.[1,2]

A sufficient volume of alveolar bone and an adequate alveolar ridge architecture are required for optimal functional and esthetic prosthesis repair after implant therapy. For successful dental rehabilitation with dental implants, the quantity of available bone is a major factor. While extensive alveolar ridge atrophy impedes the insertion of dental implants and, as a consequence, the restoration of the dental masticatory system.[3]

Prior to tooth extraction, alveolar bone loss can be caused by periodontal disease, periapical pathology, or tooth and bone trauma. During tooth extraction procedures, if the bone tissues are harmed, bone loss can occur. Alveolar bone shrinkage after tooth extraction is a well-known occurrence. Despite the fact that bone loss following tooth loss is typically three-dimensional (3D), it has been shown that horizontal deficit or width loss develops to a greater extent.[4]

So far, xenogeneic bone, either alone or in combination with autologous bone, has demonstrated promising results when utilized in conjunction with resorbable or non-resorbable membranes in GBR procedures. Implants placed following guided bone regeneration interventions had a survival rate between 91.9% and 92.2% after 12 years of observation. There is no consensus regarding the implant success rate in grafted bone as opposed to native bone.[5] Increasing numbers of patients are requesting implant-supported prostheses at present. In order to meet this demand, doctors frequently use fast implants, which increases the need for bone augmentation. We believe that disclosing the success rate of the implant in the enhanced bone is now more crucial than ever. In light of these findings, the current study set out to evaluate the success rates of dental implants placed in native bone to those placed in grafted bone.

MATERIALS AND METHOD

The present study is a retrospective, observational evaluation of patient records who underwent dental implant procedures at Department of dentistry at Van Yüzüncü Yıl University. The study was approved by the ethics committee of non-interventional clinical studies of Van Yüzüncü Yıl University (decision number: 03/03/2019).

Retrospective evaluations of the patient's information were performed with Sisoft software (Sisoft Health Information Systems Joint-Stock Company, Turkey). The data of the patients who had dental implants between January 2016 and 2018 and who had a 5-year follow-up were examined. These data included the patient's demographic information, the number and regions of implants, failed implants, whether grafting was performed or not, and if so, grafting type, technique and healing time. As for the sample size, it was considered appropriate to include all patient's data who met the inclusion criteria between January 2016-2018.

Inclusion Criteria

-Patients ages 18 and over.
-Patients who had bone level dental implant(s) with SLA surface and fixed prosthetic treatment had been completed (cemented fixed restorations).
-Patients who had horizontal bone augmentation (xenograft or xenograft+autogenous bone graft with allograft or xenograft collagen membrane).
-Patients who had a late or immediate implant placement (with or without horizontal augmentation).
-Patients who had early and long-term postoperative follow-up, and had postoperative radiographs (panoramic, periapical radiographs, and cone beam computed tomography as needed).
- Patients with ASA1.
Exclusion Criteria
-Patients who smoke.
-Patients who had vertical augmentation (with or without horizontal augmentation).
-Patients who had complications (excessive bleeding, sinus perforations, soft tissue and flap ruptures, existing infection, nerve damage and fractures of the implant body and abutment and due to this fracture implant failure) during and/or immediately after the implant surgery.
-Patients who had repeated regenerations due to

bone resorption during the follow-up period.

There were two groups of implants used in the study: Group 1, the study group, consists of implants made in the grafted bone, and Group 2, the control group, consists of implants made in the ungrafted bone. Persistent pain after dental implant placement, implant mobility, and incurable peri-implantitis were considered as implant failures. Statistical evaluation of age, sex and implant survival data in grafted bone and ungrafted bone groups was planned in 890 patients.

Statistical analysis

The statistical analysis of the study's findings was conducted using NCSS (Number Cruncher Statistical System) 2020 Statistical Software, developed by NCSS LLC in Kaysville, Utah, USA. During the analysis of the study data, numerical variables were presented using measures such as mean, standard deviation, median, minimum and maximum values. Categorical variables, on the other hand, were depicted using descriptive statistical techniques such as frequency and percentage. The normality of the data was assessed using Shapiro-Wilk test and Box Plot visualizations. The statistical method employed for assessing quantitative differences between two groups with normal distribution was the Student's t-test. The Mann-Whitney-U test was employed to assess variables that did not conform to a normal distribution across two distinct groups. The statistical methods of Chi-square test and Fisher's Exact test were employed to perform a comparison of qualitative data. A Spearman's correlation analysis was conducted based on the distribution to assess the relationships between the variables. The statistical analysis was conducted with a confidence interval of 95% and a significance level of ($p<0.05$).

RESULTS

The study comprised a total of 890 participants, with 444 identifying as male and 446 as female. The age range of the participants was 19 to 74, with a mean age of 45.17±11.07. The study involved the placement of 3170 implants across a cohort of 890 patients. The study findings indicate that a majority of the implants, specifically 88% (n=2791), were not subjected to grafting procedures. However, the overall survival rate of the implants was noted to be 98.8%. Table 1 presents the regional distribution of 379 grafted implants (Table 1). Table 2 displays the

Table 1. Distribution of Descriptive Characteristics

		n (%)
Gender	**Male**	444 (49.9)
	Female	446 (50.1)
Age	*Mean±sd*	45.17±11.07
	(Min-Max)	(19-74)
Graft	**No**	2791 (88.0)
	Yes	379 (12.0)
	Right upper	155 (40.9)
	Left upper	129 (34.0)
	Left lower	41 (10.8)
	Right lower	54 (14.2)
Implant survival	**Successful**	3132 (98.8)
	Failed	38 (1.2)

Table 2. Distribution of Implants by Regions

Implant Region	Tooth Number	n (%)
Right upper	**11**	23 (3.2)
	12	102 (14.3)
	13	68 (9.6)
	14	158 (22.2)
	15	114 (16.0)
	16	178 (25.0)
	17	68 (9.6)
	Total	711 (100)
Left upper	**21**	30 (4.1)
	22	109 (14.8)
	23	76 (10.3)
	24	166 (22.6)
	25	99 (13.5)
	26	176 (23.9)
	27	79 (10.7)
	Total	735 (100)
Left lower	**31**	26 (3.0)
	32	89 (10.3)
	33	120 (13.8)
	34	157 (18.1)
	35	92 (10.6)
	36	244 (28.1)
	37	140 (16.1)
	Total	868 (100)
Right upper	**41**	25 (2.9)
	42	82 (9.6)
	43	124 (14.5)
	44	153 (17.9)
	45	95 (111)
	46	242 (28.3)
	47	134 (15.7)
	48	1 (0.1)
	Total	856 (100)
Number of Total Implants		3170 (100.0)

regional distribution of implants (Table 2).

The statistical analysis revealed a significant difference in the rate of grafting between men and women (p=0.012; p<0.05). However, when examining the distribution of implants and grafted areas by gender, no significant difference was observed (p>0.05). (Table 3).

The statistical analysis revealed that the rate of implant survival was significantly higher in the ungrafted bone compared to the grafted bone (p=0.039; p<0.05). Upon evaluating the gender, age, and grafted regions of the patients in relation to implant

Table 3. Distribution of Implant and Graft Regions by Gender

		Gender		
		Female	**Male**	***p***
Implant Region	**Right upper**	350 (23.0)	361 (21.9)	[a]***0.576***
	Left upper	339 (22.3)	396 (24.0)	
	Left lower	426 (28.0)	442 (26.8)	
	Right lower	406 (26.7)	450 (27.3)	
Graft	**Ungrafted**	1316 (86.5)	1475 (89.4)	[b]***0.012****
	Grafted	205 (13.5)	174 (10.6)	
Graft Region	**Right upper**	81 (39.5)	74 (42.5)	[a]***0.476***
	Left upper	66 (32.2)	63 (36.2)	
	Left lower	25 (12.2)	16 (9.2)	
	Right lower	33 (16.1)	21 (12.1)	

[a]Fisher Freeman Halton Test [b]Pearson Chi-Square Test *p<0.05

Table 4. Evaluations according to implant survival

		İmplant Survival		
		Successful (n=3132)	**Failed (n=38)**	***p***
Gender	**Male**	1053 (48.0)	18 (47.4)	[b]***0.939***
	Female	1629 (52.0)	20 (52.6)	
Age	*Mean±Sd*	47.87±10.25	50.26±9.67	[c]***0.153***
	(Min-Max)	(19-74)	(28-61)	
Graft	**Ungrafted**	2762 (%98.96)	29 (%1.04)	[d]***0.039****
	Grafted	370 (%97.62)	9 (%2.38)	
Graft Region	**Right upper**	152 (41.1)	3 (33.3)	[a]***0.634***
	Left upper	124 (33.5)	5 (55.6)	
	Left lower	41 (11.1)	0 (0)	
	Right lower	53 (14.3)	1 (11.1)	

[a]Fisher Freeman Halton Test [b]Pearson Chi-Square Test [c]Student-t Test [d]Fisher's Exact Test *p<0.05

survival, no statistically significant difference was observed (p>0.05) (Table 4).

DISCUSSION

The loss of alveolar bone due to tooth extraction is a common problem, which poses a significant clinical challenge, particularly in the aesthetic zone. This pose a threat to the overall visual appearance and may also undermine the functional and structural components of the treatment. In order to attain the objective of successful extraction, there is a growing emphasis on the restoration of the alveolar ridge to guarantee the most favorable implant placement and prosthetic treatment result. To attain the goals of implant dentistry, sufficient quantities and quality of hard and delicate tissues are required. One of the most significant requirements for the placement of a

standard-sized implant at a particular site is the presence of bone volume with ample width and height to provide the necessary short- and long-term stability.[6]

Recent advancements in bone reconstruction techniques have been aimed at enhancing both the aesthetic and functional results. Nevertheless, the reestablishment of the oral function in cases of atrophic alveolar crests continues to present a significant obstacle in the field of oral implantology. The placement of implants in an optimal three-dimensional position to achieve long-term function and predictable esthetic outcomes for prosthodontic restorations is frequently facilitated by bone augmentation procedures.[7] The aforementioned methods yielded analogous durability of the implant over an extended period, while simultaneously attaining the aesthetic and operational facets.[8] Lekholm *et al*.[9] and Schliephake et al.[10] have reported elevated rates of "survival" and "success" for dental implants that were inserted into grafted bone. However, it is worth noting that the success rates for implants placed into ungrafted bone are comparatively lower. The growing utilization of reconstructive methodologies in rehabilitation and the insertion of dental implants in grafted bone necessitates an evaluation of the efficacy of implants placed in grafted regions to facilitate informed clinical decision-making.[11]

During a two-year observation period, Nevins et al.[12] conducted a study wherein 526 implants were placed in grafted bone, resulting in a survival rate of 97.5%. In contrast, Dahlin et al.[13] reported a survival rate of 100%. After 5 years, a research of Busar et al.[14] reported a 100% survival rate of implants placed in grafted bone, whereas Brunel et al.[15] and Konstantinidis et al.[16] found a survival rate of 86% In other studies, it was reported a survival rate of 97.3% for implants placed in grafted bone after one year of loading. Bazrafshan and Darby[17] reported a survival rate of 97.5% in their study, which involved the evaluation of 59 implants over a period of 35 months. Upon examination of studies that assessed the success rates of implants in non-grafted bone, following a 5-year follow-up period, Wagenberg and Froum reported a 96.1% survival rate for 401 implants placed in ungrafted bone, as also Wennström et al.[18] observed a 97.6% survival rate. In contrast, Bornstein et al.[19] reported 100% survival rates, albeit with a smaller sample size of 39 implants in each study. Upon general evaluation of the studies, it is observed that the 5-year survival rate of implants in grafted bone is comparable to that in ungrafted bone. This investigation yielded results that align with existing scholarly literature, indicating that the survival rate of implants was 97.62% in bone that had undergone grafting and 98.96% in bone that had not undergone grafting, over a period of 5 years of observation. The study revealed that while the implant survival rate was statistically superior in ungrafted bone, the implant survival rate in grafted bone was in line with the 5-year survival rate of over 97% documented in existing literature. Upon reviewing studies that assessed implant survival in both grafted and ungrafted bone, such as the study at hand, it was found that Lozada et al.[20] observed greater implant success rates in grafted posterior maxillary sinuses vs non-grafted posterior maxilla locations. The authors attributed their findings to the utilization of extended implants in the transplanted regions. Regions in contrast to the findings of Lozada et al.[20] Two retrospective studies conducted by Sbordone et al.[21] and Huynh-Ba et al.[22] respectively, reported no significant difference in the survival rates of implants placed in either native or augmented bone. The observed dissimilarities between the outcomes of the aforementioned investigations and our study can be attributed to the comparatively shorter follow-up periods and smaller sample sizes employed in those studies, as well as the limited scope of the implanted regions, which solely encompassed the posterior maxilla. The study conducted by Sesma et al.[23] documented the survival rates of 988 dual acid-etched implants that were inserted in native bone, following sinus augmentation, or after autogenous block bone-grafting procedures. The authors observed a noteworthy correlation between the occurrence of dental implant failure and the existence of bone graft in the implant region, subsequent to monitoring implant survival for a duration of 6 years post-placement. The present study revealed a diminished implant survival rate in grafted bone, which aligns with Sesma et al.[23] findings.

The present study concludes that the survival rate of implants was comparatively higher in ungrafted bone as compared to grafted bone, after a follow-up period of five years. The findings indicate

that augmenting the width of the grafted bone before or during implant surgery is a viable procedure for cases where the bone width is inadequate, as evidenced by the implant survival rate of 97.62% after a 5-year follow-up period.

REFERENCES

1. Tunçdemir A, Özcan E. İmplant destekli sabit ve hareketli protetik restorasyonlar. MKÜ Tıp Dergisi 2011;2:6.

2. Sartoretto SC, Shibli JA, Javid K, Cotrim K, Canabarro A, Louro RS, et al. Comparing the long-term success rates of tooth preservation and dental ımplants: A critical review. J Funct Biomater 2023;14:142.

3. Atieh MA, Alsabeeha NH, Payne AG, Ali S, Faggion CM, Esposito M. Interventions for replacing missing teeth: Alveolar ridge preservation techniques for dental implant site development. Cochrane Database Syst Rev 2021;4:63–9.

4. Botticelli D, Berglundh T, Lindhe J. Hard tissue alterations following. J Clin Periodontol 2004;31:820–8.

5. Chiapasco M, Zaniboni M, Boisco M. Augmentation procedures for the rehabilitation of deficient edentulous ridges with oral implants. Clin Oral Implants Res 2006;17:136-59.

6. Elangovan S. Dental implant survival in the bone augmented by direct sinus lift is comparable to implants placed in the native bone. J Evid Based Dent Pract 2020;20:101410.

7. Jensen AT, Jensen SS, Worsaae N. Complications related to bone augmentation procedures of localized defects in the alveolar ridge. A retrospective clinical study. Oral Maxillofac Surg 2016;20:115–22.

8. Buser D, Dula K, Hirt HP, Schenk RK. Lateral ridge augmentation using autografts and barrier membranes: clinical study with 40 partially edentulous patients. J Oral Maxillofac Surg 1996;54:420–32.

9. Lekholm U, Wannfors K, Isaksson S, Adielsson B. Oral implants in combination with bone grafts. A 3-year retrospective multicenter study using the Brånemark implant system. Int J Oral Maxillofac Surg 1999;28:181–7.

10. Schliephake H, Schmelzeisen R, Husstedt H, Schmidt-Wondera LU. Comparison of the late results of mandibular reconstruction using nonvascularized or vascularized grafts and dental implants. J Oral Maxillofac Surg 1999;57:944–51.

11. Laverty DP, Kelly R, Addison O. Survival of dental implants placed in autogenous bone grafts and bone flaps in head and neck oncology patients: a systematic review. Int J Implant Dent 2018;4:19.

12. Nevins M, Mellonig JT, Clem DS, Reiser GM, Buser DA. Implants in regenerated bone: Long-term survival. Int J Periodontics Restorative Dent 1998;18:35–45.

13. Dahlin C, Lekholm U, Linde A. Membrane-induced bone augmentation at titanium implants. A report on ten fixtures followed from 1 to 3 years after loading. Int J Periodontics Restorative Dent 1991;4:273–81.

14. Buser D, Ingimarsson S, Dula K, Lussi A, Hirt HP, Belser UC. Long-term stability of osseointegrated implants in augmented bone: a 5-year prospective study in partially edentulous patients. Int J Periodont Restor Dent 2002;22:109-17.

15. Brunel G, Brocard D, Duffort JF, Jacquet E, Justumus P, Simonet T, et al. Bioabsorbable materials for guided bone regeneration prior to implant placement and 7-year follow-up: report of 14 cases. J Periodontol 2001;72:257-64.

16. Konstantinidis I, Kumar T, Kher U, Stanitsas PD, Hinrichs JE, Kotsakis GA. Clinical results of implant placement in resorbed ridges using simultaneous guided bone regeneration: a multicenter case series. Clin Oral Investig 2015;19:553–9.

17. Bazrafshan N, Darby I. Retrospective success and survival rates of dental implants placed with simultaneous bone augmentation in partially edentulous patients. Clin Oral Implants Res 2014;25:768–73.

18. Wennström JL, Ekestubbe A, Grondahl K, Karlsson S, Lindhe J. Implant-supported single-tooth restorations: a 5-year prospective study. J Clin Periodontol 2005;32:567–74.

19. Bornstein MM, Schmid B, Belser UC, Lussi A, Buser D. Early loading of non-submerged titanium implants with a sandblasted and acid-etched surface. 5-year results of a prospective study in partially edentulous patients. Clin Oral Implants Res 2005;16:631–8.

20. Lozada JL, Emanuelli S, James RA, Boskovic M, Lindsted K. Root- form implants placed in subantral grafted sites. J Calif Dent Assoc 1993;1:31–5.

21. Sbordone L, Toti P, Menchini-Fabris G, Sbordone C, Guidetti F. Implant survival in maxillary and mandibular osseous onlay grafts and native bone: A 3-year clinical and computerized tomographic follow-up. Int J Oral Maxillofac Implants 2009;4:695–703.

22. Huynh-Ba G, Friedberg JR, Vogiatzi D, Ioannidou E. Implant failure predictors in the posterior maxilla: A retrospective study of 273 consecutive implants. J Periodontol 2008;12:2256–61.

23. Sesma N, Pannuti C, Cardaropoli G. Retrospective clinical study of 988 dual acid-etched implants placed in grafted and native bone for single-tooth replacement. Int J Oral Maxillofac Implants 2012;5:1243–8.