JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S7

Evaluate the survival rates in diabetic patients receiving immediate function implants

Abdulmalik Sultan A Alsuhaim[1]
Abdulaziz Ibrahim Alqudayri[2]
Hussain Bader Alomaym[3]
Abdullah Ghannam Almutairi[4]
Yaser Ebrahem Muhammd Alhusaini[5]
Ahmed Fahad M Althumairy[6]
Meshal Ghannam Almutairi[7]
Hadia Mohammed Alshammery[8]
Saud Mihmas Alaybani[9]
Abdullah Mohammad Alruwaybiah[10]
Turki Mohammed Almutairi[11]

1. Dentistry (Dental Resident), Riyadh, Riyadh Second Health Cluster / Abdulmalik.Alsohim@Gmail.Com
2. Dentistry (Dental Resident) Riyadh, Riyadh Second Health Cluster/ A.Qudery@Gmail.Com
3. Dentistry (Dental Resident), Riyadh, Riyadh Second Health Cluster/ Alomaim.Hussain@Gmail.Com
4. Dental Assistant, Riyadh, Riyadh Second Health Cluster/ Abdmutairi1122@Gmail.Com
5. Dental Technician, Riyadh, Riyadh Second Health Cluster/ Yalhusaini@Moh.Gov.Sa
6. Dentistry (Dental Resident), Riyadh, Riyadh Second Health Cluster/ Althumairyahmed@Gmail.Com
7. Or Technical, Riyadh, Riyadh Second Health Cluster/ Meshga88@Gmail.Com
8. Dentistry (Dental Resident), Riyadh, Riyadh Second Health Cluster/ Hmalshammery@Moh.Gov.Sa
9. Dental Hygiensit, Riyadh, Riyadh Second Health Cluster/Salaybani@Moh.Gov.Sa
10. Dental Lab Technician, Riyadh, King Khalid Hospital In Almjmah/ A-2.B@Hotmail.Com
11. General Dentist, Riyadh, Riyadh Second Health Cluster/ Tal-Motiri@Moh.Gov.Sa

Abstract
Background: Diabetes mellitus, a common endocrine disorder, has long been associated with increased risks of dental implant failure and excessive marginal bone loss due to impaired healing and microvascular complications. While previous studies have suggested that glycemic control is crucial for successful dental implant outcomes in diabetic patients, the exact survival rates and factors influencing marginal bone loss remain inconclusive. This study aimed to evaluate the survival rates and risk indicators for excessive marginal bone loss in diabetic patients receiving immediate function implants.
Methods: This cohort study included 70 diabetic patients (6 with type 1 and 64 with type 2 diabetes) who underwent implant-supported restorations . Implants were placed using an immediate function protocol, with clinical follow-up . Data on implant survival and complications were gathered, with radiographs taken Primary outcomes included cumulative implant survival, while secondary outcomes focused on marginal bone loss and biological complications. Statistical analysis included Kaplan-Meier survival estimates and multivariate logistic regression.
Results: A total of 352 implants were placed in 70 patients, with a 5-year follow-up. The overall implant survival rate was 89.8%, with type 1 diabetics showing a survival rate of 80% and type 2 diabetics 90.5%. Biological complications, including peri-implant pathology and fistula formation, were observed in a small proportion of patients.
Conclusion: Dental implants in diabetic patients, particularly those with well-controlled blood sugar levels, demonstrate a high survival rate (89.8%) .Proper glycemic control, infection prevention, and addressing modifiable risk factors are essential for improving long-term implant outcomes in diabetic patients.
Keywords: dental ; implants: diabetic ; survival

Introduction

Diabetes mellitus is the most widespread endocrine disorder, characterized by elevated plasma glucose levels due to defects in insulin secretion and/or action (1). It represents a major global health challenge, contributing to significant morbidity and mortality (1), with increasing interest in its association with oral health conditions. Historically, dental rehabilitation for diabetic patients was discouraged due to early and severe tooth loss caused by periodontitis, as well as a heightened risk of implant failure or infection (2).

The elevated risk in diabetic individuals was linked to microvascular complications, which can negatively impact post-surgical healing (3), leading to higher failure rates of dental implants (3) and more extensive bone loss around implants (4) when compared to non-diabetic individuals. Glycaemic control was once considered a key factor influencing implant stability, with impaired outcomes noted in type 2 diabetic patients with uncontrolled blood sugar levels (5).
However, studies examining the success of implant-supported restorations in diabetic patients have reported cumulative implant survival rates as high as 97%, with follow-up durations ranging from 1 to 12 years (6–8). Additionally, probing pocket depths of less than 3 mm were found in diabetic patients with well-controlled glycaemia (9, 10). With proper glycaemic management, infection control, and elimination of harmful factors like smoking, periodontitis, and poor oral hygiene, the success rate for dental implants in diabetic patients can reach 85–95% (11).

Materials and Methods

This study included 70 consecutive diabetic patients who received implant restorations

Inclusion and Exclusion Criteria

Patients with diabetes who underwent immediately loaded implant-supported restorations (single teeth, fixed partial prostheses, or full-arch prostheses) during the specified period were included. Diabetes was defined as a fasting plasma glucose level ≥7.0 mmol/L (126 mg/dL) or a 2-hour plasma glucose level ≥11.1 mmol/L (200 mg/dL). Exclusion criteria consisted of patients undergoing active chemotherapy or radiotherapy and those who had received bone grafting procedures at the implant site. Patients who met the inclusion criteria were identified through medical records, with controlled glycaemic status at the time of surgery.

Surgical Protocol

The surgical planning was based on clinical examination, pre-operative panoramic radiographs, and computed tomography (CT) scans. Standard procedures were followed for implant insertion (NobelSpeedy, Brånemark System® MkII, MkIII, MkIV,1). Implant site preparation aimed for a minimum insertion torque of 30 N cm^{-1} before final implant seating. Countersinking was performed only when necessary to ensure proper positioning, particularly in areas with thin bone crests. Bicortical anchorage was used when feasible. After surgery, the flap was closed with 3–0 non-resorbable sutures, and the access to the abutments was created using a punch, followed by the placement of impression copings.

Prosthetic Protocol

For single-teeth and fixed partial prostheses, final abutments were placed on the surgery day, followed by provisional screw-retained crowns or prostheses, adjusted to avoid contact with opposing teeth. After 6 months, definitive full-ceramic crowns or fixed partial prostheses were placed. For full-arch rehabilitations, provisional full-arch acrylic resin prostheses with titanium cylinders were fabricated and delivered on the surgery day. After 6 months, permanent prostheses, either full acrylic, metal-acrylic, or metal-ceramic bridges with titanium frameworks (NobelProcera Titanium framework) and acrylic resin or ceramic crowns (NobelRondo ceramics), were delivered.
Patients underwent clinical evaluations post-surgery, with subsequent follow-ups. Data on implant survival, complications, and other issues were gathered from medical records.

Primary Outcome Measures

The primary outcome measure was the cumulative implant survival rate, defined according to the Malo Clinic criteria (13). An implant was considered successful if it met the following criteria: (i) it supported the intended restoration (with "sleeping" implants classified as failures), (ii) it remained stable on manual testing, (iii) no signs of persistent infection, (iv) no radiolucency around the implant, (v) a satisfactory aesthetic outcome, and (vi) the implant-supported prosthesis provided comfort and was easy to maintain (without complaints from the patient or prosthodontist). Implants not meeting these criteria or removed were considered failures.

The study also assessed peri-implant complications, such as probing pocket depths ≥5 mm with bleeding on probing, bone resorption >2 mm, fistula formation, and suppuration.

Statistical Analysis

Descriptive statistics were used to analyze the variables of interest (marginal bone resorption, biological and mechanical complications). The Kaplan-Meier product limit estimator was employed to calculate the cumulative implant survival rate, considering the patient as the unit of analysis, with follow-up censored at 5 years. A multivariate logistic regression model was used to identify potential risk factors for bone loss greater than 2.0 mm, including history of periodontitis, cardiovascular disease, smoking, biological complications, age (≤60 years, >60 years), and gender. Odds ratios with 95% confidence intervals were estimated for each variable, both univariate and

adjusted for other factors. The threshold for excessive marginal bone loss was set at >2.0 mm (14). The significance level was set at 5%. Statistical analyses were conducted using SPSS version 17 (6).

Results

The study involved 70 diabetic patients, including six with type 1 diabetes and 64 with type 2 diabetes, aged between 41 and 80 years (mean age: 59 years). The cohort was followed for a duration of 5 years. A total of 352 implants were placed for 143 rehabilitations: 67 single-tooth restorations (35 in the maxilla and 32 in the mandible), 26 partial restorations (16 in the maxilla and 10 in the mandible), and 50 full-arch restorations (27 in the maxilla and 23 in the mandible). Among the patients, 20 were smokers, 38 had cardiovascular conditions, and 22 were identified as heavy bruxers prior to the implant procedure (Table 1).

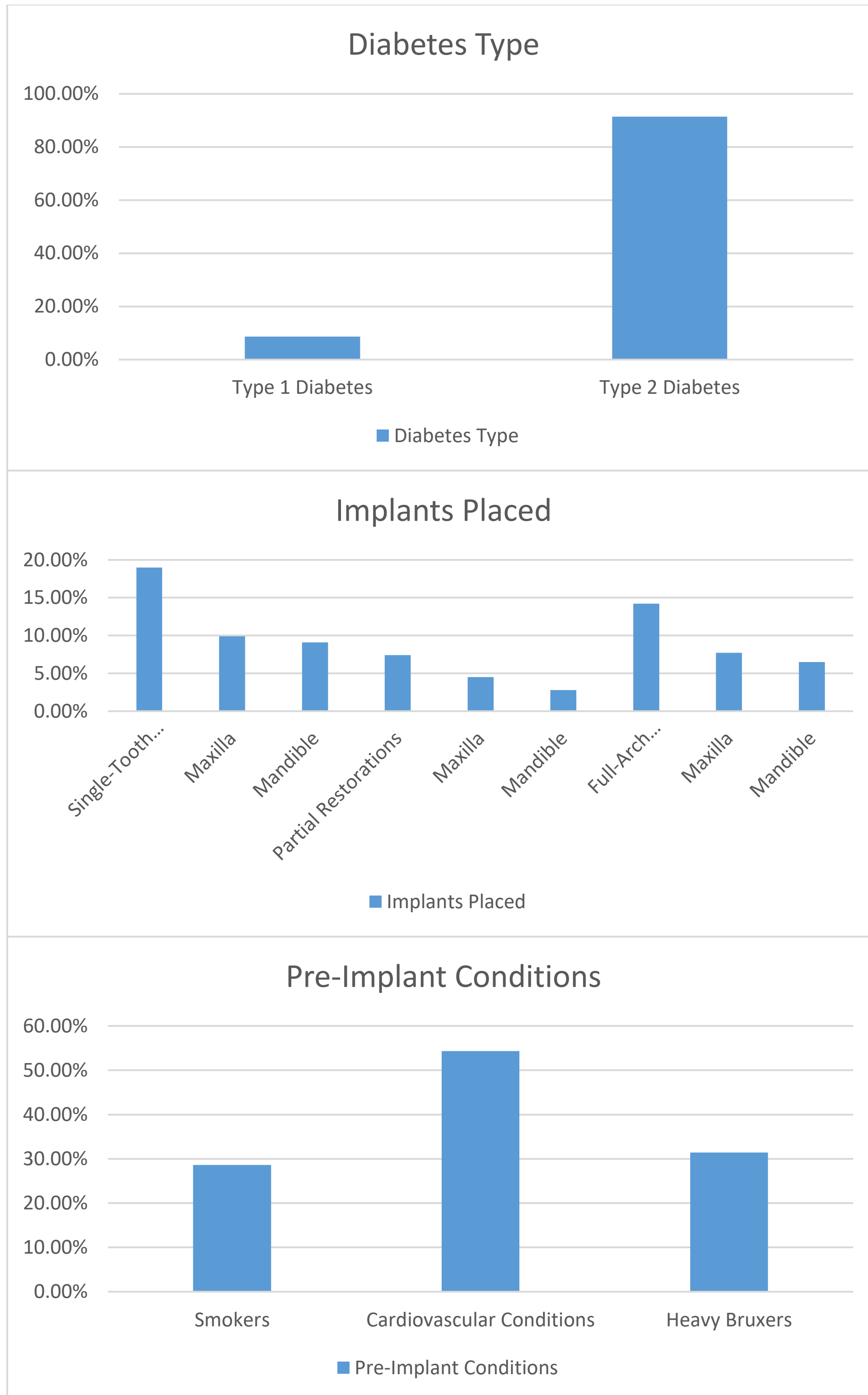
Seven patients (10%) were lost to follow-up over the course of the study. Three of these patients passed away from causes unrelated to the dental implants, and the remaining four could not be contacted.

The study found that seven patients lost 10 implants during the follow-up period, with a survival rate of 92.5% for the 93 implants placed in the maxilla and 98.1% for the 159 implants placed in the mandible, resulting in an overall survival rate of 89.8% when analyzed by patient (Table 1). Of the patients who lost implants, five lost them within the first year, while two patients lost implants between the second and third years. The survival rate for type 1 diabetic patients was 80%, whereas type 2 diabetic patients had a survival rate of 90.5% (Table 2).

Seven patients experienced biological complications, which included peri-implant pathology in six patients (8.6% of implants, 10 implants total) and one case of fistula formation (1.4% of implants, 1 implant). Fistula formation was resolved with antibiotic treatment (amoxicillin 875 mg and clavulanic acid 125 mg). Peri-implant pathology was addressed in four patients (six implants) through non-surgical methods, such as ultrasonic scaling and irrigation with 0.2% chlorhexidine gel. One patient with two affected implants died shortly after diagnosis, while another, who also had two affected implants, is currently recovering following a surgical procedure to clean the implant surface (open-flap surgery, mechanical cleaning with 0.2% chlorhexidine, suturing, and antibiotic administration).

Table 1. Demographic data:

Patient Characteristics	**Number (N)**	**Percentage (%)**
Total Patients	70	100%
Diabetes Type		
Type 1 Diabetes	6	8.6%
Type 2 Diabetes	64	91.4%
Age Range	41–80 years	-
Mean Age	59 years	-
Implants Placed	352	100%
Single-Tooth Restorations	67	19.0%
Maxilla	35	9.9%
Mandible	32	9.1%
Partial Restorations	26	7.4%
Maxilla	16	4.5%
Mandible	10	2.8%
Full-Arch Restorations	50	14.2%
Maxilla	27	7.7%
Mandible	23	6.5%
Pre-Implant Conditions		
Smokers	20	28.6%
Cardiovascular Conditions	38	54.3%
Heavy Bruxers	22	31.4%
Follow-Up Attrition		
Total Lost to Follow-Up	7	10.0%
Deceased (Unrelated Causes)	3	4.3%
Unreachable	4	5.7%


Diabetes Type
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
Type 1 Diabetes
Type 2 Diabetes
Diabetes Type
Implants Placed
20.00%
15.00%
10.00%
5.00%
0.00%
Single-Tooth...
Maxilla
Mandible
Partial Restorations
Maxilla
Mandible
Full-Arch...
Maxilla
Mandible
Implants Placed
Pre-Implant Conditions
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Smokers
Cardiovascular Conditions
Heavy Bruxers
Pre-Implant Conditions

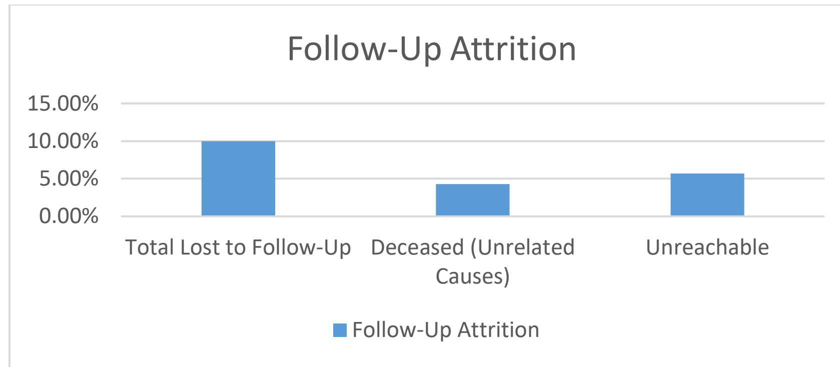


Table 2. Implant survival for patients with type 1 and type 2 diabetes mellitus (failure censored on the first incidence)

Time	Status(a)	Cumulative proportion surviving at the time		*N* of cumulative events	*N* of remaining cases
		Estimate	Standard error		
0	0	.	.	0	70
4	1	0·986	0·014	1	69
5	1	.	.	2	68
5	1	0·957	0·024	3	67
6	1	0·943	0·028	4	66
10	1	0·929	0·031	5	65
18	0	.	.	5	64
18	0	.	.	5	63
18	0	.	.	5	62
23	0	.	.	5	61
26	0	.	.	5	60
29	1	0·913	0·034	6	59
33	1	0·898	0·037	7	58
38	0	.	.	7	57
60	0	.	.	7	57
Type 1 Diabetes Mellitus					
0	0	.	.	0	6
18	0	.	.	0	5
33	1	0·800	0·179	1	4
60	0	.	.	1	4
Type 2 Diabetes Mellitus					
0	0	.	.	0	64
4	1	0·984	0·016	1	63
5	0	.	.	1	62
5	1	0·953	0·026	3	61
6	1	0·938	0·030	4	60
10	1	0·922	0·034	5	59
18	0	.	.	5	57
23	0	.	.	5	56
26	0	.	.	5	55
29	1	0·905	0·037	6	54
36	0	.	.	6	53
60	0	.	.	6	53

[a] 0: survival; 1: failure.

Discussion

This analysis indicates that implant-supported restorations offer a favorable risk/benefit ratio for diabetic patients. A recent systematic review of 16 longitudinal studies on diabetic individuals revealed implant failure rates ranging from 0% to 14.3%, which align with the findings of this study. Similarly, another review comparing implant outcomes in diabetic and non-diabetic patients found no significant difference in failure rates between the two groups, although the studies included were criticized for potential bias and confounding factors (4, 16). A prospective study spanning 1 to 12 years, involving 255 implants in diabetic patients, showed a cumulative survival rate of 97.2%, with no significant impact from factors such as age, gender, duration of diabetes, smoking, or type of hypoglycemic therapy (8). Despite numerous studies on dental implants in diabetic patients, there remains a lack of comparative research between type 1 and type 2 diabetes, an area that this study could not explore fully due to the limited number of type 1 patients, suggesting the need for further investigation.

A systematic review also noted increased marginal bone loss in diabetic patients, with similar risk indicators (4). The negative impact of smoking on implant outcomes was highlighted in previous studies, which reported significantly greater bone loss in smokers compared to non-smokers (18). Although there is limited research on specific risk factors for bone loss in diabetic patients, previous studies have observed greater bone loss in female patients compared to males in the long term (19, 20). Additionally, type 1 diabetics showed an average marginal bone loss greater than 0.2 mm per year between the first and fifth years, which does not meet international standards for implant success (17).

The incidence of biological complications in this study, specifically peri-implant pathology (8.6%), is consistent with a prior study that reported an 8.9% prevalence of peri-implant disease, with diabetic patients showing a significantly higher risk of such complications (21).

There is ongoing debate in the literature about the role of glycemic control in implant survival. Some researchers have suggested that the degree of systemic disease control may be more critical than the nature of the condition itself (22). A review focused on diabetic patients concluded that maintaining glycemic control (with HbA1c levels around 7%), along with preventive measures and management of comorbidities, could lead to implant survival rates between 85% and 95% (11). However, a cohort study found no link between elevated HbA1c levels and impaired short-term implant survival in type 2 diabetics (23). This study, which examined mandibular implants, proposed that bone density might play a more significant role in implant survival than glycemic control. Similarly, this study found a higher failure rate for maxillary implants compared to mandibular implants, suggesting that bone density could be more influential than glycemic control in determining the success of implant-supported restorations.

Conclusion

The findings may not be fully generalizable due to the specific demographic of diabetic patients undergoing implant-supported restorations, a slight male gender overrepresentation, and a wide age range (39 years). Future research should explore the impact of glycemic control and its interaction with comorbidities on the long-term success of implant-supported restorations.

References

1. Mellado-Valero A, Ferrer García JC, Herrera Ballester A, Labaig Rueda C. Effects of diabetes on the osseointegration of dental implants. *Med Oral Patol Oral Cir Bucal*. 2007; **12**: E38–E43.
2. Michaeli E, Weinberg I, Nahlieli O. Dental implants in the diabetic patient: systemic and rehabilitative considerations. *Quintessence Int*. 2009; **40**: 639–645.
3. Katyayan PA, Katyayan M, Shah RJ. Rehabilitative considerations for dental implants in the diabetic patient. *J Indian Prosthodont Soc*. 2013; **13**: 175–183.
4. Chrcanovic BR, Albrektsson T, Wennerberg A. Diabetes and oral implant failure: a systematic review. *J Dent Res*. 2014; **93**: 859–867.
5. Oates TW, Dowell S, Robinson M, McMahan CA. Glycemic control and implant stabilization in type 2 diabetes mellitus. *J Dent Res*. 2009; **88**: 367–371.
6. Balshi TJ, Wolfinger GJ. Dental implants in the diabetic patient: a retrospective study. *Implant Dent*. 1999; **8**: 355–359.
7. Peled M, Ardekian L, Tagger-Green N, Gutmacher Z, Machtei EE. Dental implants in patients with type 2 diabetes mellitus: a clinical study. *Implant Dent*. 2003; **12**: 116–122.
8. Tawil G, Younan R, Azar P, Sleilati G. Conventional and advanced implant treatment in the type II diabetic patient: surgical protocol and long-term clinical results. *Int J Oral Maxillofac Implants*. 2008; **23**: 744–752.
9. Tatarakis N, Kinney JS, Inglehart M, Braun TM, Shelburne C, Lang NP *et al*. Clinical, microbiological, and salivary biomarker profiles of dental implant patients with type 2 diabetes. *Clin Oral Implants Res*. 2014; **25**: 803–812.

10. Turkyilmaz I. One-year clinical outcome of dental implants placed in patients with type 2 diabetes mellitus: a case series. *Implant Dent*. 2010; **19**: 323–329.
11. Marchand F, Raskin A, Dionnes-Hornes A, Barry T, Dubois N, Valéro B *et al*. Dental implants and diabetes: conditions for success. *Diabetes Metab*. 2012; **38**: 14–19.
12. vonElm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Epidemiology* 2007; **18**: 800–804.
13. Maló P, de Araújo Nobre M, Lopes A, Ferro A. Gravito I. All-on-4® treatment concept for the rehabilitation of the completely edentulous mandible: a 7-year clinical and 5-year radiographic retrospective case series with risk assessment for implant failure and marginal bone level. *Clin Implant Dent Relat Res*. 2015; **17**(Suppl 2): e531–e541.
14. Misch CE, Perel ML, Wang HL, Sammartino G, Galindo-Moreno P, Trisi P *et al*. Implant success, survival, and failure: the International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. *Implant Dent*. 2008; **17**: 5–15.
15. Oates TW, Huynh-Ba G, Vargas A, Alexander P, Feine J. A critical review of diabetes, glycemic control, and dental implant therapy. *Clin Oral Implants Res*. 2013; **24**: 117–127.
16. Cheng LL. Limited evidence suggests no difference in implant failure rates among people with or without diabetes. *J Am Dent Assoc*. 2015; **146**: 549–551.
17. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. *Int J Oral Maxillofac Implants*. 1986; **1**: 11–25.
18. Vervaeke S, Collaert B, Cosyn J, Deschepper E, De Bruyn H. A multifactorial analysis to identify predictors of implant failure and peri-implant bone loss. *Clin Implant Dent Relat Res*. 2013; **17**: e298–e307.
19. Mir-Mari J, Mir-Orfila P, Valmaseda-Castellón E, Gay-Escoda C. Long-term marginal bone loss in 217 machined-surface implants placed in 68 patients with 5 to 9 years of follow-up: a retrospective study. *Int J Oral Maxillofac Implants*. 2012; **27**: 1163–1169.
20. Wagenberg BD, Froum SJ, Eckert SE. Long-term bone stability assessment around 1,187 immediately placed implants with 1- to 22-year follow-up. *Int J Oral Maxillofac Implants*. 2013; **28**: 605–612.
21. Ferreira SD, Silva GL, Cortelli JR, Costa JE, Costa FO. Prevalence and risk variables for peri-implant disease in Brazilian subjects. *J Clin Periodontol*. 2006; **33**: 929–935.
22. Diz P, Scully C, Sanz M. Dental implants in the medically compromised patient. *J Dent*. 2013; **41**: 195–206.
23. Oates TW Jr, Galloway P, Alexander P, Vargas Green A, Huynh-Ba G, Feine J *et al*. The effects of elevated hemoglobin A(1c) in patients with type 2 diabetes mellitus on dental implants: survival and stability at one year. *J Am Dent Assoc*. 2014; **145**: 1218–1226.