SJMS | E-ISSN: 2833-3772 | Volume 2, Issue 4 | July-August 2023

The Scientific Journal of Medical Scholar

Publisher: Real-Publishers Limited (Realpub LLC)

30 N Gould St Ste R, Sheridan, WY 82801, USA

Co-Publisher: SSESD, Egypt

Website: https://realpublishers.us/index.php/sjms/index

The Scientific Journal of Medical Scholar

Available online at Journal Website
https://realpublishers.us/index.php/sjms/index
Subject (Dentistry and Oral Surgery)

Original Article

The Effect of Diabetes (Controlled vs. Non-Controlled) on Dental Implant Success.

Khaled Alayan* | **Abdulmutalib Rahab**

Department of Periodontics Faculty of Dentistry and Oral Surgery, Alasmarya Islamic University, Zlitin, Libya.

Article information

Submitted: May 10th, 2023

Accepted: June 23th, 2023

DOI: 10.55675/sjms.v2i4.59

Citation: Alayan K, Rahab A. The Effect of Diabetes (Controlled vs. Non-Controlled) on Dental Implant Success. SJMS 2023; 2 (3): 103-107. DOI: 10.55675/sjms.v2i4.59

ABSTRACT

Background and Aim: Among the fixed prosthodontics for replacing missing teeth is the use of dental implants. Implants give stability, a more natural appearance, and reduce the danger of bone resorptions and atrophy since they are immediately fixed into bones. Yet, research studies revealed that individuals with diabetes mellitus experienced a slower recovery process following operation because of microangiopathies, lowered host defense, the generation of advanced glycation end products (AGEs), reduced generation of collagen, and raised collagenase activity. Individuals with diabetes mellitus might not be a good candidate for dental implants. Because of this, people with diabetes have a substantially greater probability of dental implant failure than healthy people. In this experimental study, controlled and non- controlled diabetic patients were assessed in terms of implants success 90 days from the operation.

Methods: 100 controlled and other 100 non- controlled cases of type 2 diabetic patients with one or more missing teeth were chosen. Local infiltration anesthesia was used during implantation. Every participant received 0.2% chlorohexidine mouthwash for 14 days after having their wounds sutured. After 90 days and before loading, assessments were carried out to check Implants osseointegration by reverse torque test denoted by the torque wrench.

Results: Out of 300 implants in 100 non-controlled diabetics, 70 implants failed (not osseointegration) after 90 days, whereas 10 out of 200 implants in controlled diabetic subjects had their implants failed. Some implants were removed because they were deemed unsuccessful.

Conclusions: The rate of implant failure in non-controlled diabetics was much higher than in controlled diabetics.

Keywords: Dental Implant; Osseointegration; Bone Resorption; Diabetes Mellitus.

* Corresponding author
Email: k.alayyan@asmarya.edu.ly

INTRODUCTION

The World Health Organization estimates that over 180 million individuals globally have diabetes mellitus, which ranks among the most prevalent medical conditions, and that by 2030, that figure would have doubled [1].

Diabetes mellitus is a chronic illness that develops when the body's blood glucose levels are too high [2]. This typically occurs when the pancreas' synthesis of the hormone insulin, which is necessary to control blood glucose levels, is insufficient or whenever the body has trouble using the insulin that is produced [3]. Glucose intolerance and hyperglycemia are symptoms of diabetes mellitus. Elevated blood glucose levels are referred to as hyperglycemia, a disease, whereas insulin resistance is linked to a lack of tolerance for glucose [4]. Type 1 and type 2 diabetes make up most cases of the disease. The hallmark of type-1 diabetes (referred to as insulin-dependent or childhood-onset diabetes) is a deficiency in the synthesis of insulin [5].

The body's improper utilization of insulin results in type 2 diabetes, also known as noninsulin-dependent or adult-onset diabetes. It frequently happens because of weight gain and inactivity [6, 7]. Diabetes mellitus has an impact on the circulatory system and is linked to several problems, including cardiovascular disorders, especially heart attack and stroke [8]. Additionally, it was recently discovered that diabetes slows down the recuperation of injuries and bones and has been linked to the breakdown of one dental prosthodontics and consequently dental implants [9].

Prosthodontics is a specialized branch of dentistry dedicated to making dental prosthetics (artificial teeth) for damaged or missing teeth. Contrary to other conventional prosthodontics, implants immediately attach to bones, giving the new tooth strength, a natural-looking appearance, and reducing the likelihood of bones atrophy and resizing [10]. Consequently, dental implants are growing in acceptance today. Both osseointegration and periodontal wound rehabilitation are involved [11]. According to investigations, people with diabetes mellitus recover more slowly following the operation, putting the tissues at risk for problems such tissues necrosis. Furthermore, osseointegration was hampered by streptozotocin-induced diabetes, according to animal research [12]. Migrations, adhesion, proliferation, and differentiation of a variety of cells occur during the wound healing process. Owing to the decreased vascular supply brought on by microangiopathies, decreased host defense, generation of advanced glycation end products (AGEs), decreased collagen synthesis, and elevated collagenase enzyme production in people with diabetes, the recovery process may be slowed down [13, 14]. Individuals with diabetes mellitus may not be a good candidate for dental implants due to these side effects [15]. Non-controlled diabetes patients have a significantly greater incidence of dental implants failure than people with controlled diabetes [16].

In this study, it was intended to investigate the success rate of non-controlled diabetic individuals who had dental implants.

MATERIALS AND METHODS

Study design: This was a retrospective comparative observational study.

Study setting: The study was conducted from June 2021 to January 2022 at Amman dental center and easy smile dental center in Tripoli.

Study sample: Participants with dental implants totaling 200 participants were chosen.

Inclusion criteria: One or more missing teeth within one 6 months prior to the trial were the selection criterion for subjects. 200 participants were split into two distinct categories: those with uncontrolled diabetes (100 patients) and those with controlled diabetes patients (100 patients). This classification was adopted according to analysis of glycated hemoglobin (HbA1c) in blood which provides evidence about an individual's average blood glucose levels during the previous three months, which is the predicted half-life of red blood cells (RBCs).

A Hemoglobin A1c (HbA1c) has been assessed for all participants. Participants whose HbA1c level was greater than 8% indicate non-controlled diabetes, whereas HbA1c level equal to or less than 7% indicates controlled diabetes case. The controlled type 2 diabetes individuals received metformin 1000 mg BID monotherapy for a minimum of twelve months. Ninety days were spent observing each participant.

Exclusion criteria: Any diabetic patient with low quantity of bone (less than 10 mm in height and/or less than 6.5 mm in thickness), any diabetic patient whose HbA1c level scored more than 7% to 8% were excluded from the study, presence of any other non-controlled systemic disease and/or hormonal disorders and smoking patients were also excluded.

Preoperative procedures: Pre-operative procedures were carried out before dental implants. For determining the heights and thickness of the alveolar bones, standard X-ray, panoramic images, and clinical examination were used. One day prior to the operation, patients took an antibiotic (Augmentin 1g x2 for seven days starting one day before surgery) orally as a preventative measure to avoid inflammations brought on by pathogenic microbes. Individuals used mouthwash containing 0.12% chlorine three times preceding operation.

Dental implants: Dental implanting operations were carried out utilizing the super line implant system (Dentium Company, South Korea) beneath local infiltration anesthesia (2% Lidocaine). To show bones over the implants site, surgical incision was created on the alveolar crest and a relief incision was performed on the mesio-distal edge. A flap with the entire thickness was

raised. The bone's location was then prepared using a special drilling. Implants were at bone level or 1 ml lower. The primary stability on the surgery day was from 30 to 50 Ncm denoted by the torque wrench according to the manufacturer instructions (Figure 1). All implants were covered by cover screw. Soft tissues flaps were also stitched back, for one week after surgery. In addition, the recipients were supplied with Paracetamol tab 500mg S.O.S and mouthwash containing 0.2% chlorohexidine for 14 days following operation to stop the development of bacteria. Throughout the study duration, controlled diabetic patients took anti-glycemic medications.

Implants osseointegration: On bone implantology, stability of a dental implant is an essential clinical tool during osseointegration evaluation, as it reflects the structural and functional connection between the bone and the implant.

Each participant's total number of teeth that have osseointegrated with bones was counted. The reverse torque test proposed by Roberts *et al*. in 1984, and developed by Johansson and Albrektsson [17], is considered as a special advantage in stage 2 surgery, because it represents a definitive clinical verification of initial integration of the dental implant with the bone surface. The torque level required is commonly expressed in Newton centimeters (Ncm) [18, 19]. This way, a clinical evaluation is made of the perception of any movement of the dental implant, after a specific counterclockwise force up to 30 Ncm. It represents an objective diagnostic tool, easy to apply, cheap, non-invasive, and capable of discriminating between a stable and a mobile implant.

Ethical considerations: The patients were informed of the experimental nature of the investigation and its publication; corresponding informed consents were signed prior to participation in this investigation after the research procedures had been authorized by the ethical boards at Amman dental center and Easy smile dental center in Tripoli.

Statistical analysis: The Mann-Whitney test was used to compare means between controlled and non-controlled diabetes patients as well as compare means within the same group. Student t-test was used to analyze implant success or failure rate. All data were collected, coded, and analyzed using SPSS version 26.0 (SPSS Inc., USA).

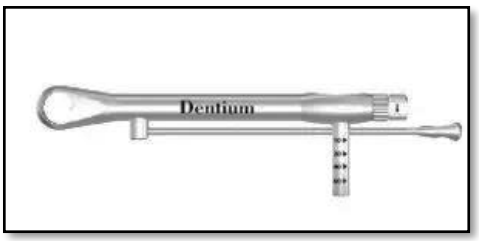

Figure (1): Torque wrench tool.

RESULTS

General characteristics of the studied patients

Given a mean age of 45.6 and ages varying from 37 to 51, the 200 diabetic individuals were split between 94 females and 106 males with a BMI of 29 ±4.47 kg/m2.There were 100 individuals in the controlled diabetic group: 46women and 54 men and 100 participants in the non-controlled diabetes group: 48 women and 52 men (Table 1).

In 100 type II controlled diabetic individuals, 200 dental implants were introduced. 90 days following the operation, 20 implants (10%) had failed (Table 2). Among the 100 type- II diabetes non-controlled patients, 70 out of 300 (23.3%) implants had failed. The difference in success and failure rates between the two groups was statistically significant (X^2=90.749, p< 0.05).

Table (1): The non-controlled diabetic group's traits

Parameters		Patients number and references values (n=200)	Non-controlled Diabetes group (n=100)	Controlled diabetes group (n=100)
Sex	Female	94 (47%)	48 (48%)	46 (46%)
	Male	106 (53%)	52 (52%)	54 (54%)
Age	>40 years	77	30 (30%)	47 (47%)
	<40 years	123	70 (70%)	53 (53%)
	Mean (Min-Max) (years)	45.6 (37-51)	42.3 (37-48)	44.3 (39-51)
Body mass index (kg/m^2)	Mean ± SD	29 ±4.47	28.5 ± 3.66	29.1 ± 3.78
Body height(m)	Mean ± SD	1.58 ± 1.3	1.66 ± 1.14	1.59 ± 1.09
Body weight (kg)	Mean ± SD	82.6 ± 10.7	79.85 ± 11.02	81.38 ± 9.89
Hypertension (mmHg)	Mean ± SD	151/96 ± 6/2.6	150/91 ± 6/3.1	135/84 ± 7/3.9
Type of diabetes		II	II	II

Table (2): Osseontegration of two groups' implants 90 days following implant placement.

Degree of mobility	Non-controlled Diabetes Group (n= 300)	Controlled diabetes Group (n= 200)
	Number of mobile implants(%)	Number of mobile implants (%)
II º Mobility	70 (23.33%)	20 (10%)
0-I º Mobility	230 (76.7%)	180 (90%)

DISCUSSION

According to the findings of the study, people with non-controlled type 2 diabetes had a much lower success rate for dental implants than patients with controlled diabetes. It was in line with other studies' findings that people with diabetes mellitus had a greater chance of dental implants failing [20-22]. Dental implants are not recommended for people with uncontrolled chronic conditions including diabetes and heart diseases, according to recent trials [23, 24].

Osseointegration is crucial for the success of the tooth implant's healing. As implants have been exposed to operational loads, operational recovery occurs when the implant's surface heals with bones tissues without the interposition of connective tissues. Osteoclasts and osteoblasts participate in the remodeling of the bones throughout this phase [20, 25].

In a related study, researchers discovered that 17 (4.5%) of the 377 dental implants implanted in diabetes patients failed following the first phase of the operation, giving the implants a survival percentage of 95.49% throughout their recovery [1]. This is in accordance with the observations of **Tawil *et al.*** [26], **Farzad *et al.*** [27] **and Olson *et al.*** [28], where the survival rates were sequentially 97.2%, 90%, 96.3% and 94.3%. This might be related to the implants failing throughout the first recovery phase, which would indicate that it was improperly osseo-integrated. There are several causes for these alterations, one of which is the decreased bone-implants contact [29]. Additionally, it has been demonstrated that if the patients had appropriate glycemic control, this condition might be reversed [30]. This justification led to the exclusion of research participants who had HbAc1 levels greater than 8% at the time of implants placement since they were deemed to have moderately or poorly managed diabetes. The failure prevalence of implants in diabetes patients ranges from 4.4% to 14.3%, as reported by **Marchand *et al.*** [31]. Individuals with additional illnesses that could have had an impact on the study's findings were also eliminated. 16 out of 365 implants in the control group failed at the first stage, with a survival percentage of 95.61 percent [1].

In patients with diabetes, **Olson *et al.*** [28], and **Farzad *et al.*** [27] saw an 88.0%, 94.1%, and 99.1% successful implant rates, accordingly. Even with diabetic geriatric individuals, a success score of 92.7% was recorded [32]. This may be due to microvascular complications in those with diabetes, wherein most failures happened following the second stage of operation and during the first year of normal load [27].

Success rates over time after operational loading and osseointegration within the first year are considered when estimating the survival percentage for implants. In general, implants survival is viewed as the culmination of the therapeutic process. The Alberktsson guidelines were used to identify unsuccessful implants. It was shown that implant failure typically occurred more frequently following functional loads [33].

Conclusion: To conclude, individuals with non-controlled diabetes mellitus had a lower success rate with dental implants osseointegration. For those who have diabetes mellitus, more research is needed to know how diabetes affect the implant osseointegration, how blood glucose management increase the success rate of implant dentistry and finally more trials are needed on longer periods for follow-up cases after implant loading.

Financial and non-financial relationships and activities of interest: None.

REFERENCES

1. Sghaireen MG, Alduraywish AA, Srivastava KC, Shrivastava D, Patil SR, Al Habib S, et al. Comparative evaluation of dental implant failure among healthy and well-controlled diabetic patients—A 3-year retrospective study. Int J Environ Res Public Health. 2020;17(14):5253. doi: 10.3390/ijerph17145253.
2. Lagunov VL, Sun J, George R. Evaluation of biologic implant success parameters in type 2 diabetic glycemic control patients versus healthy patients: A meta-analysis. J Investig Clin Dent. 2019;10(4):e12478. doi: 10.1111/jicd.12478
3. Ormianer Z, Block J, Matalon S, Kohen J. The Effect of Moderately Controlled Type 2 Diabetes on Dental Implant Survival and Peri-implant Bone Loss: A Long-Term Retrospective Study. Int J Oral Maxillofac Implants. 2018;33(2). doi: 10.11607/jomi.5838.
4. Al Zahrani S, Al Mutairi AA. Crestal bone loss around submerged and non-submerged dental implants in individuals with type-2 diabetes mellitus: a 7-year prospective clinical study. Med Princ Pract. 2019; 28 (1): 75-81. doi: 10.1159/000495111.
5. Wagner J, Spille JH, Wiltfang J, Naujokat H. Systematic review on diabetes mellitus and dental implants: an update. Int J Implant Dent. 2022;8(1):1-21. doi: 10.1016/j.jdiacomp.2005.05.006.
6. Javed F, Romanos GE. Chronic hyperglycemia as a risk factor in implant therapy. Periodontol 2000. 2019;81(1):57-63. doi: 10.1111/prd.12283.
7. Jiang X, Zhu Y, Liu Z, Tian Z, Zhu S. Association between diabetes and dental implant complications: a systematic review and meta-analysis. Acta Odontol Scand. 2021;79(1):9-18. doi: 10.1080/00016357.2020.1761031.
8. Singh K, Rao J, Afsheen T, Tiwari B. Survival rate of dental implant placement by conventional or flapless surgery in controlled type 2 diabetes mellitus patients: a systematic review. Indian J Dent Res. 2019;30(4):600. doi: 10.4103/ijdr.IJDR_606_17.
9. Nourah D, Aldahlawi S, Andreana S. Should the quality of glycemic control guide dental implant therapy in patients with diabetes? Focus on implant survival. Curr Diabetes Rev. 2022;18(4):8-15. doi: 10.2174/1573399817666210806120300.

10. Andrade CAS, Paz JLC, de Melo GS, Mahrouseh N, Januário AL. Survival rate and peri-implant evaluation of immediately loaded dental implants in individuals with type 2 diabetes mellitus: A systematic review and meta-analysis. Clin Oral Investing. 2022:1-14. doi:10.1007/s00784-021-04154-6.

11. Almehmadi AH. Awareness of population regarding the effects of diabetes on dental implant treatment in Jeddah, Saudi Arabia. Heliyon. 2019;5(9):e02407. doi: 10.1016/j.heliyon.2019.e02407.

12. Latimer JM, Roll KL, Daubert DM, Zhang H, Shalev T, collaborators As, et al. Clinical performance of hydrophilic, titanium-zirconium dental implants in patients with well-controlled and poorly controlled type 2 diabetes: One-year results of a dual-center cohort study. J Periodontol. 2022;93(5):745-57. doi: 10.1002/JPER.21-0015.

13. Sultana R, Raj A, Barbi W, Afridi SK, Mishra BP, Malik R. A comparative study evaluating implant success and bone loss in diabetes and nondiabetes. J Pharm Bioallied Sci. 2021;13(Suppl 2):S1410. doi: 10.4103/jpbs.jpbs_229_21

14. Wu Y-s, Wang Y, Yuan Q. Dental Implant Treatment for Diabetic Patients. Dental Implant Treatment in Medically Compromised Patients. 2020:103-27. doi: 10.1007/978-3-030-28557-9

15. Halpern LR, Adams DR. Medically complex dental implant patients: controversies about systemic disease and dental implant success/survival. Dent Clin. 2021;65(1):1-19. doi: 10.1016/j.cden.2020.08.001.

16. Sbricoli L, Bazzi E, Stellini E, Bacci C. Systemic diseases and Biological Dental Implant Complications: A Narrative Review. Dent J. 2022; 11 (1): 10. doi: 10.3390/dj11010010.

17. Johansson C, Albrektsson T. Integration of Screw Implants in the Rabbit: A 1-yr Follow-up of Removal Torque of Titanium Implants. Int J Oral Maxillofac Implants. 1987;2(2). doi: 10.4317 - /medoral.20353.

18. Jividen Jr G, Misch CE. Reverse torque testing and early loading failures: help or hindrance? J Oral Implantol. 2000;26(2):82-90. doi: 10.1563/1548-1336 (2000)026<0082:RTTAEL>2.3.CO;2

19. Atsumi M, Park S-h, Wang H-L. Methods used to assess implant stability: current status. Int J Oral Maxillofac Implants. 2007;22(5). doi: med/17974108.

20. 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(1):38-43. doi: 17195826

21. Scully C, Hobkirk J, D DIOS P. Dental endosseous implants in the medically compromised patient 1. J Oral Rehabil. 2007; 34 (8):590-9. doi: 10.1111/j.1365-2842.2007.01755.x.

22. Klokkevold PR, Han TJ. How do smoking, diabetes, and periodontitis affect outcomes of implant treatment? Int J Oral Maxillofac Implants. 2007;22(7). doi: 18437796.

23. Fonseca VA. Identification and treatment of prediabetes to prevent progression to type 2 diabetes. Clin Cornerstone. 2008;9(2):51-61. doi: 10.1016/ S1098-3597(09)62039.

24. Bianchi C, Miccoli R, Penno G, Del Prato S. Primary prevention of cardiovascular disease in people with dysglycemia. Diabetes care. 2008; 3 (Suppl_2):S208-S14. doi: 10.2337/dc08-s256.

25. Javed F, Romanos GE. Impact of diabetes mellitus and glycemic control on the osseointegration of dental implants: a systematic literature review. J Periodontol. 2009;80(11):1719-30. doi: 10.1902/jop.2009.090283.

26. 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(4). doi: 18807573.

27. Farzad P, Andersson L, Nyberg J. Dental implant treatment in diabetic patients. Implant Dent. 2002; (3):262-7. doi: 10.1097/00008505-200207000-00011.

28. Olson JW, Shernoff AF, Tarlow JL, Colwell JA, Scheetz JP, Bingham SF. Dental endosseous implant assessments in a type 2 diabetic population: a prospective study. Int J Oral Maxillofac Implants. 2000;15(6). doi: 11151579.

29. 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(2):117-27. doi: 10.1111/j.1600-0501.2011.02374.x.

30. Oates Jr TW, Galloway P, Alexander P, Green AV, Huynh-Ba G, Feine J, et al. The effects of elevated hemoglobin A1c in patients with type 2 diabetes mellitus on dental implants. J Am Dent Assoc. 2014;145(12):1218-26. doi: 10.14219/jada.2014.93.

31. Marchand F, Raskin A, Dionnes-Hornes A, Barry T, Dubois N, Valéro R, et al. Dental implants, and diabetes: conditions for success. Diabetes Metab J. 2012;38(1):14-9. doi: 10.1016/j.diabet.2011.10.002.

32. AI Jabbari Y, Nagy WW. Implant dentistry for geriatric patients: A review of the literature. Quintessence Int. 2003;34(4). doi: 12731615.

33. Albrektsson T, Zarb G, Worthington P, Eriksson A. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. Int j oral maxillofac implants. 1986;1(1):11-25.

SJMS | E-ISSN: 2833-3772 | Volume 2, Issue 4 | July-August 2023

The Scientific Journal of Medical Scholar

Publisher: Real-Publishers Limited (Realpub LLC)

30 N Gould St Ste R, Sheridan, WY 82801, USA

Co-Publisher: SSESD, Egypt

Website: https://realpublishers.us/index.php/sjms/index