

To what extent should dental implant placement be adopted as a standard for diabetic patients?

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ABSTRACT

يُعتبر داء السكري أحد أكثر الأمراض المزمنة الشائعة بالعالم، حيث أن الزيادة المزمنة لنسبة السكر في الدم تؤدي إلى مضاعفات مرضية أخرى تؤثر على خلايا الجسم المختلفة، ومن إحدى مضاعفات هذا المرض هو التهاب الفم والأنسجة المحيطة بالأسنان. أثبتت الدراسات أن المرضى الذين يكون لديهم تقلبات في نسبة السكر في الدم عن النسب الطبيعية بشكل متكرر يكون لديهم آثار سلبية تؤثر على الفم والأنسجة المحيطة بها، حيث قام الكثير بدراسة نسب نجاح زراعة الأسنان لدى هؤلاء المرضى فأتضح أن نسبة نجاحها أقل نسبياً عند المقارنة بأقرانهم الغير مصابين، ولكن أثبت طب الأسنان المبني على البراهين أن نسبة نجاح زراعة الأسنان لدى مريض السكري تعتمد على عوامل أخرى مثل نسبة السكر في الدم إضافة إلى بعض الإحتياجات التي تزيد من نسبة نجاح العملية الجراحية لزراعة الأسنان.

Diabetes mellitus (DM) is considered one of the major chronic diseases in the world. Long-term hyperglycemia considerably affects the body tissues, and consequently, can lead to morbidity and mortality. Moreover, many oral complications have been observed with DM but little consideration in relation to the placement of dental implants has been investigated. Dental research has analyzed the relation of dental implants and bone osseointegration in diabetic patients. Theoretically, an impaired immune system and delayed wound healing of these patients might decrease the success rate of implant placement; however, with noticeable advances in evidence-based dentistry and statistically significant results, successful implant treatment could be achieved significantly in well-controlled diabetic patients.

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Recently, diabetes mellitus (DM) has become one of the most common metabolic disorders in the world.¹ There are greater than 25 million people worldwide suffering from this disease.² For instance, in the United Kingdom, there are 3.9 million people suffering from diabetes.³ Moreover, it is estimated that in 2014, there were 387 million diabetic patients all over the world, and this number is expected to rise to 592 million by 2035.³ These patients suffer from various systemic complications that affect their body organs, such as cardiovascular diseases, increased blood sugar levels, and eye diseases.⁴ Furthermore, they may have oral complications, such as dry mouth and dental caries.⁵ It is common for diabetic patients to have multiple missing teeth as a result of periodontal diseases, which are associated with metabolic disorder. Thus, to improve their mastication function, psychological well-being, and cosmetic concerns, replacing missing teeth in these patients is one of the most common dental procedures. Currently, dental implants are increasing in use for replacing missing teeth. According to the American Implant Association, a dental implant is a titanium screw used to support one or more missing teeth.⁶ It integrates into the jawbone to replace the root of a tooth when it is lost. Diabetic patients are ideal candidates for dental implant placement. However, there is evidence in the literature to suggest that impaired wound healing in diabetic patients is an issue that needs to be considered when performing this procedure in such patients.⁷ This review aims to discuss different modalities to achieve ultimate oral health status with dental implants in diabetic patients. By using evidence-based dentistry (EBD), we aim to explain the controversial theories of dental implant placement in diabetic patients.

Diabetes mellitus. According to the American Diabetes Association, DM is defined as a chronic endocrinal disease characterised by glucose intolerance

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Table 1 - Oral complications among diabetic patients.

Oral complications	Researchers	Year of publication	Most relevant conclusions
Salivary gland dysfunction	Saavedra et al ³²	2015	Salivary gland dysfunction markers in type 2 diabetes mellitus patients
Periodontitis	Defronzo et al ³³	2015	Screening dental clinics have shown to detect undiagnosed diabetes cases
Orofungal infection	Shenoy et al ³⁴	2014	Glycemic control status of the diabetic patients may directly influence candidal colonisation
Lichen planus (LP)	Narayan et al ³⁵	2013	Stress and anxiety among diabetic patients suggest the existence of LP
Denture stomatitis and angular cheilitis	Al-Maweri et al ³⁶	2013	Higher occurrence of oral mucous lesions was significantly associated with poor metabolic control
Temporomandibular joint dysfunction and tooth loss	Borgnakke et al ³⁷	2016	Associated with diabetic neuropathy was found to be the most common reason

associated with numerous complications.⁴ Many studies have assessed oral complications in relation to hyperglycemia (Table 1). Additionally, it is widely accepted that diabetic complications can be microvascular (small blood vessels) and macrovascular (large blood vessels) (Table 2), affecting the oral cavity with subsequent peri-implant bone loss.⁸ For instance, improper wound healing around the dental implant with weak integration to the jawbone is one of the challenges faced by dentists. Furthermore, the significant metabolic disorder in DM could affect the normal physiological process of healing mechanisms.⁹ However, dental implant placement needs an ultimate level of integration into the jawbone to achieve successful results and to avoid the complications in medically compromised patients, in particular diabetic patients.¹⁰ For this reason, the dental treatment plan has been modified and different treatment modalities have been enhanced to achieve a high quality of oral health services. Implant placement depends on case selection and requires many parameters to achieve positive results and successful treatment for patients. Future complications are expected, and the true longevity of implants might be impossible to achieve.¹¹

Impact of healing process in diabetic patients.

Ajami et al¹² reported that diabetic patients have a tendency for delayed bone healing and an impaired osteoconduction mechanism around the integrated bone screw, resulting in failure of the dental implant. A systemic literature study¹³ has proven a successful dental implant osseointegration in well glycemic-controlled diabetic patients in comparison with non-diabetic subjects. In addition, biomedical research has improved the dental implant concept in combination with clinical practice to be more relative to patient outcomes.

Evidence-based dentistry has suggested various medical considerations for diabetic patients to achieve

Table 2 - Long-term systemic complications of diabetes mellitus.

Microvascular complications	Macrovascular complications
Retinopathy	Heart disease
Autonomic neuropathy	Peripheral vascular diseases
Nephropathy	Cerebrovascular diseases
Periodontal disease	Renal failure
Sexual dysfunction	Hypertension

successful bone healing around the dental implant and to overcome the complications of high blood glucose levels. Moreover, well-controlled blood glucose levels will enhance the physiological structure of the whole body at the clinical and subclinical levels, ultimately improving the healing process.¹⁴ Recently, a systemic review and meta-analysis published by medical scientists at the University of Malmo observed that well-controlled diabetic patients could be considered as healthy subjects. “*The difference between the patients (diabetic versus non-diabetic) did not significantly affect implant failure rates (p=0.65), with a risk ratio of 1.07 (95% confidence interval=0.80, 1.44)*”.¹⁵

These statistical results illustrate that well-controlled blood glucose levels are regarded as the gold standard to achieve ultimate healing process and to improve the integration of the dental implant in the jawbone. Thus, a dental implant is a relative contraindication in diabetic patients rather than an absolute contraindication.

Rationale of antibiotic prophylaxis in diabetic patients. It seems that diabetic patients have a tendency for dental infection, which is an extremely serious medical condition if it occurs in the bone. Hegab states that diabetic patients are more prone to dental infection due to a dysfunction in their immune system, which means that they may be more prone to bone infection around the dental implant.¹⁶ Furthermore, the microorganisms of the mouth may increase the

likelihood of infection around the implant.¹⁷ However, although diabetic patients have a tendency for dental infection, EBD and biological oral studies provide measurements to decrease the chance of infection and avoid the normal bacteria in the mouth acting as a risk factor.

There is, perhaps, some evidence that the influence of antibiotics in medically compromised patients, such as diabetic subjects, is effective in decreasing dental infection.¹⁸ For instance, the use of an antibiotic prophylactic increases the success rate of dental implants by 96.47%.¹⁹ Recently, medical scientists at the University of Ohio compared the effectiveness of different types of antibiotics before the surgical placement of the dental implant.²⁰ They found that antibiotics tended to reduce dental infection and minimise inflammation to a greater extent.

It is routinely sufficient to administer 2 g of amoxicillin pre-operatively (one hour before the procedure) as a prophylactic prior to dental implant placement.²¹ Additional post-operative antimicrobial doses might lead to adverse side effect, such as severe allergic reaction that requires hospital admission.²¹ Additionally, Escalante et al²⁰ suggested that preoperative administration of 500 mg of azithromycin helps in reducing post-surgical inflammation of dental implant placement more than 2 g of amoxicillin.²⁰ However, there is no obvious agreement and recommendation regarding the type and dose of antimicrobial that can be considered prior to the dental implant placement.²²

These studies clearly showed that prophylactic antibiotics are among the most important factors to accelerate the healing process around the implant by decreasing the risk of infection, thereby significantly increasing the dental implant success rate. Moreover, studies suggest that mouthwash could be used as an antiseptic agent before and after dental implant therapy.²³ In addition, researchers at the University of Pisa, Italy,²⁴ assessed the effectiveness of mouthwash on 40 diabetic patients and observed a clear significant effect of 0.12% concentration of antiseptic mouth rinse. Furthermore, they found that there is an obvious clinical enhancement in bone implant integration. Consequently, this clinical study proved that antiseptic mouthwashes could significantly affect the quality of the healing process by decreasing the rate of dental infection.

Impact of glycemic control in the success rate of dental implant. It seems that hyperglycemia, which is an increase in the blood glucose level above the normal level, could affect the success rate of the dental implant. According to Gonnelli et al,²⁵ diabetic patients have a tendency for low bone formation that could result

in a bone fracture.²⁵ This poor bone quality is usually caused by inconsistent blood glucose levels, which affect the bone cells that are responsible for bone formation. Furthermore, Alsaadi et al²⁶ claimed that the integration of the implant into the diabetic jawbone is disorganised.²⁶ Thus, the disorganised bone tends to increase the possibility of a bone fracture. However, this study evaluated the quality of the dental implant in diabetic patients with non-controlled diabetes rather than assessing the situation in well-controlled diabetic patients. Moreover, this study examined the validity of implant dentistry in diabetic patients with other systemic diseases.

Nevertheless, although the quality of bone in hyperglycemic patients may affect the integration of the dental implant and the surrounding jawbone, it is worth nothing that most of the failure rates in implant therapy are related to poorly controlled diabetes. There is a distinct lack in the impact of the updated knowledge and advancement in clinical research that has demonstrated positive outcomes of implant therapy in diabetic patients. In accordance with dental research, a clinical study conducted at the University of Texas Health Science Centre in San Antonio stated that the survival rate of dental implants was 99% after one year of follow up in 117 diabetic patients. They received 2 implants with a total 234 dental implants.⁷ Furthermore, Jadhav et al²⁷ in their systemic review of diabetic patients, made it clear that the success rate of dental implants was determined largely by glycemic control. *“Diabetes is no contraindication for implant placement, on condition that it remains under metabolic control.”*²⁷

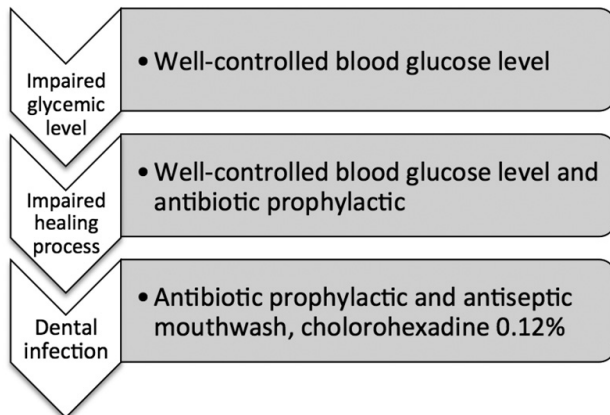
It is recommended to measure the HbA1c (Glycosylated Hemoglobin Assay) prior dental implant placement procedure.²⁷ The HbA1c assists in determining the average blood glucose level during the 2-3 months. It is well known that HbA1c has been classified into 3 different levels (6-8% as well controlled diabetes, 8-10% as moderate, and >10% poorly controlled diabetes).²⁸ Although Khandelwal et al²⁹ reported that poorly controlled diabetes (7.5-11.4%) have successful implant placement, studies^{30,31} clearly show that well controlled diabetic patients have less peri-implantitis and better implant survival rate.

These results have shown that the survival rate of dental implants in diabetic patients has increased significantly. In addition, it has clearly shown that the failure rate of implant therapy in diabetic patients in the previously mentioned studies should be interpreted with caution due to of the lack of knowledge on recent advances in clinical dental research (Table 3).

Table 3 - Studies show successful dental implant placement in well-controlled diabetic patients.

Researchers	Number Of implants	Survival rate %	Blood glyceimic level	Type of study	Year of publication
Erdogan et al ³⁸	43	95 (DI) and 100 (DII)	controlled	prospective	2015
Turkayilmaz et al ³⁹	23	100	controlled	prospective	2010
Wing Loo et al ⁴⁰	346	86	controlled	prospective	2009
Alsaadi et al ⁴¹	719	96	controlled	retrospective	2008
Baishi et al ⁴²	18	100	controlled	prospective	2007
Huang et al ⁴³	52	90.4	controlled	prospective	2004
Pleed et al ⁴⁴	141	97.3	controlled	prospective	2003

DI - diabetes type I, DII - diabetes type II

**Figure 1** - The most common causes of dental implant failure in diabetic patients.

In conclusion, it is clearly shown that the failure rate of dental implant placement in diabetic patients should be interpreted with caution. However, EBD in relation to biomedical clinical studies has proven that successful treatment using dental implants can be achieved significantly in well-controlled diabetic patients. In general, medical considerations for achieving better integration of dental implants in diabetic patients are well controlled HbA1c, use of prophylactic antibiotics and 0.12% antiseptic mouthwash (Figure 1).

Further clinical trial studies are required in conjunction with regular follow up to assess the longevity of dental implants in human subjects rather than animal models. Moreover, involving other medical professionals and adjusting anti-diabetic medication doses are critical to achieve an ultimate standard of oral healthcare. Studies show other major factors that must be evaluated as it can affect success rate of the treatment such as type of dental implant, placement protocol, and loading protocol. Therefore, dental practitioners must update their knowledge on DM regularly to provide a high standard of dental treatment and to encourage their patients to control their HBA1c, enabling them

to be suitable candidates for treatment with dental implants. Additionally, patient education through social media and community campaigns is required to achieve an ultimately effective oral health service.

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