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The Success Rate of Dental Implants in Patients with Diabetes Mellitus - A Review

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Review Article

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Abstract: Diabetes Mellitus is the most common of the endocrine disorders which is characterized by increased plasma glucose levels. This hyperglycaemic state can be due to defect in insulin secretion, insulin action, or both. It has been considered as one of the main causes of morbidity and mortality in modern society and has become an alarming public health problem. Implants have become an important therapeutic modality in the last decade. To improve the global success rate of implants and reduce the risk of complications, involving periimplantitis, resorbtion; identification of suitable patients and standardization of the procedures are mandatory. So this article is reviews the evidences suggesting the effect of diabetes mellitus on osseointegration, success and failure rates of implants.
Keywords: diabetes mellitus, endosseous implant, periimplantitis.

INTRODUCTION

Diabetes Mellitus is the most common of the endocrine disorders which is characterized by increased plasma glucose levels. This hyperglycaemic state can be due to defect in insulin secretion, insulin action, or both.

The words “diabetes mellitus” come from a combination of Latin and Greek languages. The Rhode Island Medical Society explains that, diabetes is from the Greek — meaning “that which passes through,” and mellitus is from the Latin word for honey (mellis), hence sweet. There are two main types of diabetes which includes type 1 and type 2 diabetes.

Type 1 diabetes is associated with pancreatic β- cell destruction and accounts for 5% to 10% of the subjects with diabetes whereas Type 2 diabetes is associated with a relative insulin deficiency and it accounts for 90% to 95% of all individuals with diabetes [1].

There is considerable evidence to suggest that periodontal disease and diabetes are linked together in a cycle. Diabetes is a risk factor for periodontitis, which appears to develop at least twice as often in diabetics as in populations without diabetes.

In addition, periodontal infection can affect glycaemic control in diabetic patients. These coexisting conditions can lead to the gradual loss of tooth attachment to alveolar bone, resulting in tooth loss [1]. Becoming partially or totally edentulous is the possible outcome, and is known as the “sixth complication” of diabetes.

Dental implant treatment in edentulous patients has been shown to be effective with great success in the longitudinal studies. The most common type of dental implant is end osseous implant.

Treatment can fail because of premature loss of the implant or defects in osseointegration, leading to eventual implant failure [2]. Literature evidences suggests that successful treatment results can be obtained when implants were placed on patients with glycosylated haemoglobin levels (HbA1C) less than 7 percent and with possible prophylactic antibiotic administration [3].

To improve the global success rate and reduce the risk of complications, identification of suitable patients and standardization of the procedures are mandatory [3]. This can be achieved only when there is an enough literature support to prove success and failure rates along with various recommendations to improve the global success rates. So this article is reviews the evidences suggesting the effect of diabetes mellitus on osseointegration, success and failure rates, the available measures that have been proven to improve the percentages of implant survival rate.

DIABETES MELLITUS – AN OVERVIEW

Diabetes mellitus is a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Depending on the etiology of DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization, and increased glucose production.

DIABETES AND DENTAL HEALTH

In the oral environment it has been associated with xerostomia, increased levels of salivary glucose and an increased incidence of caries. It is also a risk factor for oral pathology including gingivitis, periodontitis, candidiasis, and oral lichen planus. In addition, other oral manifestations have been reported, such as ketonic breath (sweet breath), residual bone resorption, periodontal abscess, gingival overgrowth, vascular alterations and blood coagulation [5].

It has been stated that, diabetes mellitus is an important and independent risk factor for development of gingivitis and periimplanitis. It is the increased susceptibility to infection that likely predisposes diabetics to periodontal disease, as well as the state of chronic inflammation that likely worsens glucose levels for diabetics. Because of this strong association, *the* characterized severe periodontitis as the sixth complication of diabetes [6].

Diabetes and periodontitis

The periodontitis linked systemic diseases may be caused by an oral–hematogenous spread. *Porphyromonas gingivalis*, a gram negative microorganism, is implicated as a major causal species in the initiation and progression of periodontal disease.

Aspriello *et al*. [7] in his paper on "Diabetes associated periodontitis" have explained the inflammatory process of periodontitis. During the inflammatory process, four molecules play a fundamental role: *C - reactive protein* is a plasmatic protein, associated with alveolar bone loss. *Interleukin-1β* also plays a pivotal role in chronic inflammation, and attachment loss in periodontitis patients. *Interleukin-6* synergizes with IL-1β to enhance the recruitment and formation of osteoclasts, which induce bone resorption. *Tumor necrosis factor- α* is involved in upregulating the production of collagenase, prostaglandin E_2, chemokines, cytokines and cell adhesion molecules, as well as stimulating bone resorption-related factors. Individuals with diabetes mellitus react with an abnormally higher release of IL-1β and TNF-α causing bacterial accumulation and peri implantitis

DENTAL IMPLANT AND DIABETES

Implant placement as a treatment choice

Dental implants are inert, alloplastic materials embedded in the maxilla and/or mandible for the management of tooth loss and to aid replacement of lost orofacial structures as a result of trauma, neoplasia and congenital defects. The most common type of dental implant is endosseous implant

An intimate relationship between the bone and the implant becomes established during the healing process, known as "osseointegration".This process is indispensable for the stability and longevity of the implant, which secondarily supports the prosthetic element. A prerequisite condition is that there must be sufficient osseous bone surrounding the implant – approximately 1 mm in depth. Failure or absence of osseointegration is mostly characterized by the loss of bone around the base of the implant.

Endosseous-implant treatments can be successful for the replacement of lost teeth; diabetes is still considered a risky condition when undertaking such treatment.

Dental-implant placement can also be compromised in these individuals, as alveolar bone loss may be pronounced; postoperative infection and delayed wound healing are relevant concerns in individuals with chronic periodontitis. Uncontrolled diabetes result in periimplantitis and subsequent failure of implant, so emphasis is now being placed on preventive measures to manage periodontitis in the preoperative setting

Table-1: Recommendations to reduce the risk of implant failure in diabetic patients

1. Good glycaemic control: • HbA1c < 7% • Baseline and pre-prandial glycaemia (mg/dL): 80 - 110 • Maximum post-prandial level of glycaemia (mg/dL): < 180 2. Antibiotic therapy 1 Preoperative Regimen: Oral administration of 2 g amoxicillin one hour before surgical procedure 2 Post Operative Regimen: Oral administration of 500 g amoxicillin every 8 hours for 7- 10 days 3. Additional therapy • 0.12% chlorhexidine mouthwash

Precautionary measures to be taken in diabetic patients

- Comprehensive health history should be obtained from every candidate for implant therapy. If the patient has a history of diabetes, additional information should be gathered about his or her current treatment
- If the diabetic patient's metabolic control appears to be clinically inadequate, implant therapy is best delayed until better control is achieved. A figure of less than 7% for HbA1c is considered a good level of glycemic control
- The doctor should stress to the patient the importance of taking all diabetic medications on the days of surgery and maintaining an acceptable level of metabolic control throughout the healing period
- A ten-day regime of broad-spectrum antibiotics should be started on the day of surgery to reduce the risk of infection. Amoxicillin (2 gm per os 1 hour previously),.Clindamycin may also be used (600 mg per os 1 hour previously), azithromycin .
- In addition to antibiotic prophylaxis, the use of 0.12% chlorhexidine mouthwash has shown a clear benefit.
- The deleterious impact of smoking on osseointegration has been well documented. The combination of smoking and diabetes may substantially increase the risks of implant failure.

DISCUSSION

Review of the literature

Investigators, Year	Aim	Study design	Statistical methods	Outcome	Main conclusions
Prakash PSG *et al*. [8]	To study the reports on the influence of surgically placed dental implants.	Clinical	NA	Positive	High success rate is achievable when dental implants are placed in diabetic patients whose disease are under control
Yong Han *et al.* 2012 [9]	To determine whether local insulin delivery using a fibrin gel(FG) loaded with insulin/ poly(lactic-co-glycolic acid) microspheres (FGIPM) improves biomechanical retention of titanium implants in type 1 diabetic rats.	Experimental	ANOVA	positive	Local insulin delivery ameliorated the biomechanical retention of titanium implants in type 1 diabetic rats.
Von Wilmowsky C *et al*. [10]	To investigate the effect of diabetes on peri- implant bone formation in an animal model of human bone repair.	Experimental	Mann-Whitney U-test	Negative	Poorly controlled diabetes negatively affects peri-implant bone formation and bone mineralization.
Miao Yu *et al.* [11]	To investigate the hypothesis that a mesenchymal stem cells (MSC)-implant complex could be used in type 2 diabetics.	Experimental	ANOVA	Positive	MSC implant complexes possess osteogenic and vascularisation abilities and increases the implant success rate in diabetic patients.
Kuchler *et al.* [12]	To clarify the effects of PTH administration on osseointegration under conditions of hyperglycemia	Experimental	ANOVA	Negative	Metabolic controls of diabetes might be a critical determinant when diabetic patients are undergoing anabolic therapy to enhance osseointegration.
Oates *et al*. [13]	To test the hypothesis that poor glycemic control is directly related to short-term- impairment implant stabilization.	Clinical	ANOVA	Positive	Differences in implant stability changes in relation to low and high HbA1c levels
Tawil *et al.* [14]	To investigate the effect of type 2 diabetes on implant survival and complication rate.	Clinical	Student t and Mann-Whitney tests; Wilcoxan signed -rank test	Positive	Implant survival in individuals with well-controlled diabetes is similar to that of controlled group without diabetes.

The bibliography reviewed recommends good glycaemic control in the peri-operative period in order to improve the survival rates for implants in diabetics. HbA1c figures of less than 7% indicate appropriate glycaemia levels. Pre-operative antibiotic therapy and the use of 0.12% chlorhexidine mouthwash are recommended as both measures have been shown to reduce the percentage of failures.

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