

## Review Article

### Dental implants in glyceemic patients: state for accomplishment- a systematic review

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#### **ABSTRACT:**

The enlarged acceptance of diabetes mellitus has become a global health problem. Hyperglycaemia entails a rise in the morbidity and mortality in diabetic patients. Although a direct relationship with periodontal disease has already been shown, little is known about the results of dental implants in diabetics. This paper reviews various literatures about the effect of diabetes on the osseointegration of implants and the healing of soft tissue. In experimental models of diabetes, a reduced level of bone-implant contact has been shown, and this can be reversed by means of treatment with insulin. Compared with the general population, a higher failure rate is seen in diabetic patients. Most of these occur during the first year of functional loading, seemingly pointing to the microvascular complications of this condition as a possible causal factor. These convolutions also compromise the healing of soft tissues. It is necessary to take certain marked considerations into account for the deployment of implants in diabetic patient. A good control of plasma glycaemia, together with other measures, has been shown to improve the percentages of implant success in these patients.

**Key words:** Diabetes Mellitus, hyperglycaemia, osseointegration, Dental implants.

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#### **Introduction**

Recent studies in India [1] has shown that the number of diabetic individuals has surpassed the estimate of IDF-2009 [2]. Diabetes mellitus is a group of metabolic disorders characterized by hyperglycaemia, liberation of glucose by liver. This hyperglycaemia is the result of a defect in insulin secretion, insulin action, or both. It is one of the main causes of morbidity and mortality in modern society and has become an alarming public health problem. Diabetes mellitus affects the blood circulations and is associated with many complications such as retinopathy, ischaemic heart disease, nephropathy, cerebrovascular disease, neuropathy and peripheral arterial diseases [3, 4]. Chronically high levels of

plasma glycaemia lead to the onset of chronic vascular complications of this condition, a frequent cause of morbidity and mortality in these patients (Figure.1). The treatment of diabetes aims at achieving optimal metabolic control so as to avoid or delay these complications [5]. Over the last few years, special importance has been given to the relationship between diabetes and oral pathologies. Concerning the effect on oral tissues, [6] recognized the periodontal disease as sixth major complication of diabetes. Number of studies has proved the adverse effect of chronic hyperglycaemia on oral mucosa and with some controversies on alveolar bone.

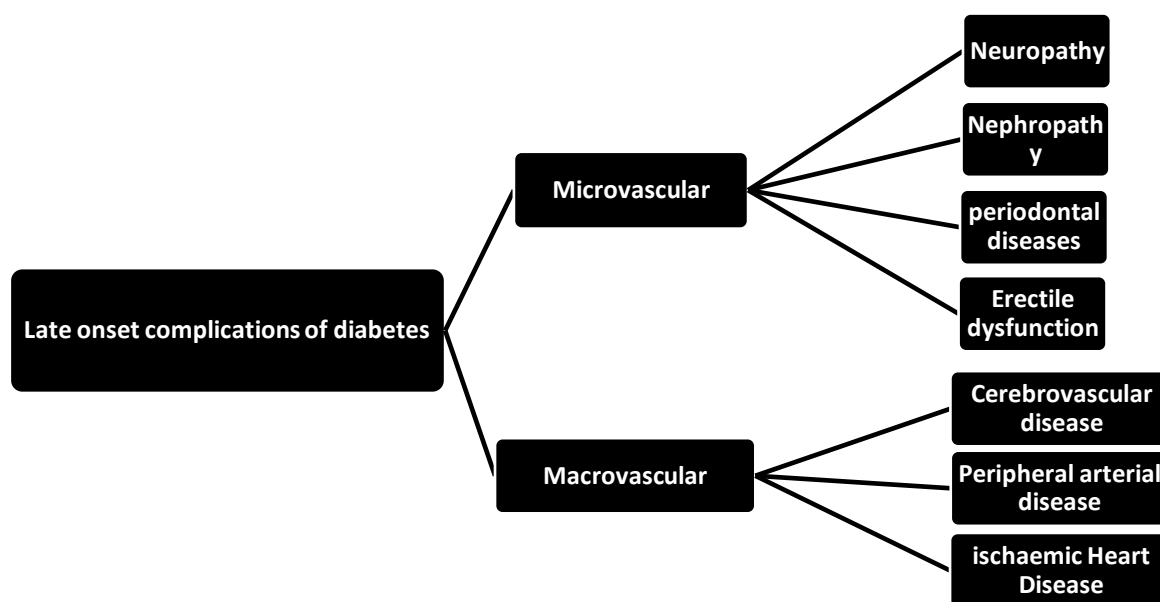


Figure 1: Late-onset complications of Diabetes.

The effect of diabetes on dental implants has not yet been cleared up. The present article will review the implications of diabetes and glycaemic control for the prognosis and evolution of dental implants, in order to establish, if possible, a series of special considerations for these subjects.

**Diabetes and its effect on bone and fracture healing**

Diabetes mellitus is a metabolic disorder that increases fracture risk and interferes with bone formation and impairs fracture healing. Type 1 diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM) both increase fracture risk and have several common features that affect bone including hyperglycaemia and increased inflammation. These factors affect both osteoblasts and osteoclasts lead to increased osteoclasts and reduced numbers of osteoblasts and bone formation. In addition to fracture healing, T1DM and T2DM impair bone formation under conditions of perturbation such as bacteria induced periodontal bone loss, which reduces expression of factors that stimulate osteoblasts such as BMPs and growth factors and increase osteoblast apoptosis (figure 2).

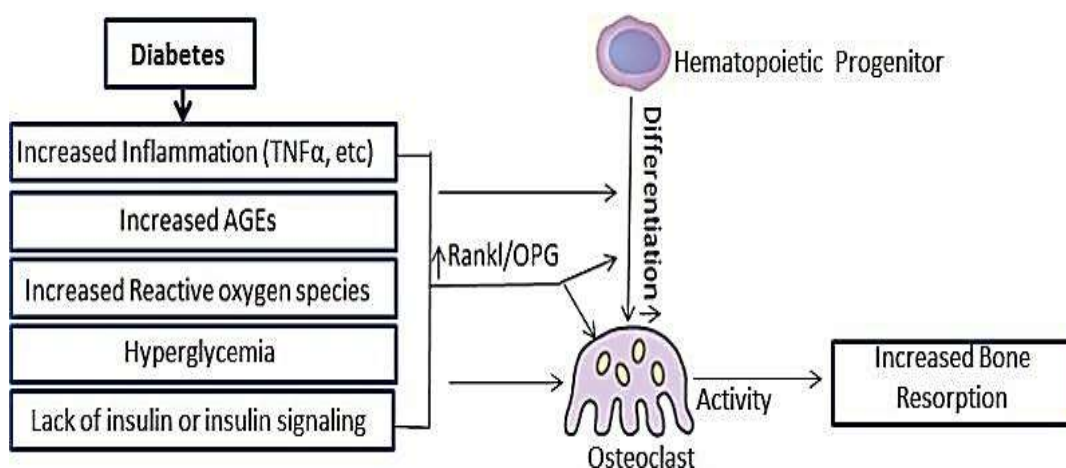


Figure 2: Mechanisms of diabetes-increased osteoclastogenesis

Diabetes leads to hyperglycaemia, enhanced and prolonged inflammation, formation of AGEs and generation of ROS. This dysregulation as well as reduced insulin signalling may lead to increased osteoclast formation, particularly when bone is challenged by wounding; bacteria induced inflammation or other events that disrupt homeostasis. This dysregulation may lead to an increased RANKL/OPG ratio or affect osteoblasts through other mechanisms to increase bone resorption.

Type 1 diabetes produces a reduction in bone mineral density through mechanisms that have not yet been sufficiently clarified; it has been attributed to both a lower formation of bone and also to a greater rate of bone loss [7]. This alteration has not been demonstrated in patients with type 2 diabetes and, in some studies, it even seems that there is greater bone mineral density than in the control subjects [8, 9]. Experimental models of type 2 diabetes have shown a reduction in both bone formation and bone resorption, which might explain this apparently contradictory effect [10].

**Strategies for placing dental implant in diabetic patient**

The physiological events associated with the “stress” of a procedure can affect both diabetic control and cardiac function. Consequently, the clinician treating a patient with diabetes mellitus must develop treatment strategies that, take into consideration the patient’s overall health and, in particular, the patient’s cardiovascular status [11, 12].

- **Medical consultant:** Medical consultation is further required if the anticipated dental therapy may adversely impact good glycaemic control [13 - 16].
- **Timing and length of appointments**
- **Use of local anesthetic agents** with oral benzodiazepine, nitrous oxide, or intravenous sedation.
- **Use of antibacterial agents:** The reciprocal relationship between infection and poor glycaemic control has led some to advocate the administration of antimicrobial prophylaxis prior to dental therapy, particularly in the patients with poorly controlled diabetes [17 ,18].( Table.2)

- Good glycaemic control:
  - HbA1c,7%
  - Baseline and pre-prandial Glycemia (mg/dl): 80 – 110
  - Maximum post-prandial level of Glycemia (mg/dl) <180
- Pre-Operative antibiotic therapy
- Chlohexidine Mouthwash

**Table 2: Recommendation to reduce the risk of implant failure in diabetic patients.**

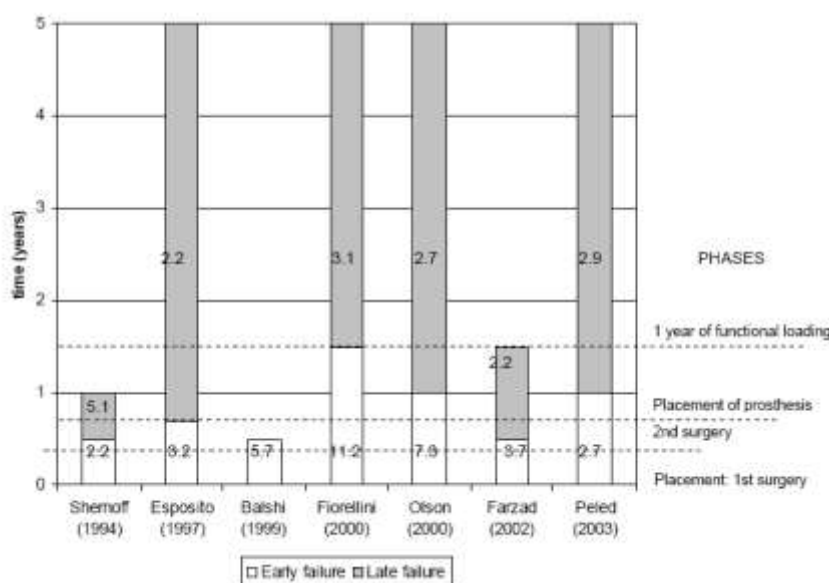
**Survival/ failure of implant in patients with diabetes mellitus**

Reviewing the literature published in the last 10 years, the survival rate for implants in diabetic patients ranges between 88.8% and 97.3% one year after placement, and 85.6% to 94.6% in functional terms one year after the prosthesis was inserted.

Only two studies[19, 20] reported significantly high failure of implant in diabetic patients even when glucose level was adequately under control.

One of these studies retrospectively included early, as well as late failures of implants over the period of 10 years but did not specify the glycaemic control over that period. While other study, prospective in nature, observed significantly high early failures with probable reason that placement of multiple adjoining implants in diabetic patients increased the failure rates due to large wound, delayed healing and greater force posed over implants.

The fact that most failures occur after the second-phase surgery and during the first year of functional loading might indicate microvascular involvement is one of the factors implicated in implant failures in diabetic patients [21, 22]. The percentages of failures in these studies are shown graphically in (figure 3 )



**Figure 3. Graph of the percentage of failure in diabetic patients.**

- The left axis shows the time elapsed since the placement of the implants.
- The right axis reflects the different phases from the placement of the prosthesis.
- The numbers in the columns indicate the percentages of failure in two distinct stages for each study. Early failure included up to one year of functional loading. Late failures have been monitored for up to 5years.

**Discussion**

Most of the experimental studies have been indicated that the bone matrix formation and bone mineralization was almost equal in controlled diabetic and non-diabetic animals . Number of studies has proposed and explained mechanism of deleterious effect of diabetes over wound healing and osseointegration of bone to implant surface. However studies, performed in humans specifically with diabetes type-2, observed insignificant effect over bone and accordingly good osseointegration of dental implant in controlled diabetic patients[[23]. Most of clinical studies reported survival of dental implant in diabetic individual as good as normal patients. The reason may appear to be the inclusion of controlled diabetics in the almost all studies. The persistent hyperglycaemia is responsible for development of micro-vascular complication and consequently the early or late implant failure [23]. Hence the uncontrolled level of diabetes, reflected through measurement of glycated haemoglobin HbAc1 [23], persistent for longer duration with sign of micro-vascular complication may affect the success of dental implant significantly. Even the fairly or moderately controlled diabetes persisting for very longer duration may produce complications and diminish the health of tissues. The compromised condition along with some adverse restorative factors may bargain the success of dental implants. Therefore, numerous factors associated with rehabilitation and diabetes itself, affect the survival of dental implant in diabetic subjects. Careful consideration of the mentioned factors during rehabilitation, improve success of implants in diabetic patients (Table 2).

Factors Associated with diabetes	Rehabilitative factors
<ul style="list-style-type: none"> <li>▪ Type of diabetes</li> <li>▪ Diabetes duration</li> <li>▪ Diabetes control i.e. level of diabetes control reflected through HbAc1 level</li> <li>▪ Status of diabetic complication i.e. micro- and/or macro- angiopathy/-absent/ mild/ moderate/ severe</li> <li>▪ Method of controlling hyperglycemia through dietary control/ oral hypoglycemic/ insulin administration</li> </ul>	<ul style="list-style-type: none"> <li>▪ Type of restoration</li> <li>▪ Fixed/ Removable</li> <li>▪ Long span/ short span</li> <li>▪ Implant Location</li> <li>▪ Maxillary/ Mandibular</li> <li>▪ Anterior/ Posterior</li> <li>▪ Implant length</li> <li>▪ Bone type and quality</li> <li>▪ Surgical protocols</li> <li>▪ Surgical Complexity</li> <li>▪ Duration for osteointegration before second surgery and functional loading</li> </ul>

**Conclusion**

Dental implants are safe and predictable procedures for dental rehabilitation in diabetics. Patients with poorly controlled diabetes seem to have delayed osseointegration following implantation. Avoiding the immediate loading of the implants is advisable. There are some fine indicators that well controlled glycemia improves osseointegration and implant survival. Therefore, to avoid other long-term reactions, the practitioner should ask for the HbA1c, and if necessary, the improvement of antidiabetic treatment should be aimed. Bone augmentation procedures such as guided bone regeneration and sinus lifts have a higher complication and failure rate in patients with well- to fairly well-controlled diabetes. To improve the implant survival and to reduce the post-operative complications, a supportive therapy consisting of prophylactic antibiotics and chlorhexidine mouth rinse is recommended.

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