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Review Article

Osseointeration of dental implants in diabetic patients-A review

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Abstract

Osseointegration is dental condition characterized by close apposition of new and reformed bone in congruence with the fixture, so that there is no interposition of connective tissue or fibrous tissue. Diabetes Mellitus is a metabolic syndrome characterised by hyperglycaemia due to absolute or relative deficiency of insulin. In the present review, an attempt has been done to study the clinical aspects where oesstointeraction is observed in diabetic patients, methods of its recovery in various dental procedures.

Keywords : Osseointegration, Diabetes mellitus

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Introduction

Diabetes Mellitus is a clinical syndrome characterised by hyperglycaemia due to absolute or relative deficiency of insulin. According to WHO statistics there are 31.7 million patients in year 2000 suffering from diabetes in India and it is projected around 79.4 million by 2030. Diabetes originates in many different ways (table-1) but is mostly due to autoimmune type 1 diabetes or to adult -onset type 2diabetes. Chronically high levels of plasma glycaemia are associated with a wide range of systemic complications (table-2 and table-3). In oral cavity, diabetes mellitus is associated with xerostomia, swelling of the parotid gland, and an increased incidence of caries and periodontitis [1]. Today there is little data available concerning the impact of diabetes on dental implants [2]. The purpose of this review was to present the literature on osseointegration of dental implants success in patients with diabetes.

Osseointegration

Osseointegration is defined as the close apposition of new and reformed bone in congruence with the fixture, so that there is no interposition of connective tissue or fibrous tissue at light microscopic level [3].

The mechanism of osseointegration between bone tissue and implant surface is clearly the key to implant success. The concept of osseointegration was developed by Branemark in the middle 1960s and led to the predictable long term success of oral implants. Osseointegration mechanism is very similar to the primary bone healing. After surgical trauma, there is an inflammatory process, in which a mediator cascade promotes hematoma. The fate of hematoma is further influenced by whether regeneration or repair process (Figure-1) [4-6].

Review of literature

This review identifies the conclusions and deficiencies on dental implants success in patients with diabetes and presents systemic and rehabilitative considerations for improving treatment outcome. Relevant clinical studies were searched through medline and reviewed.

Animal Studies

Studies [7- 9] have shown that there is reduction in bone-implant contact in diabetes. But it may be reversed by treating hyperglycaemia and maintaining near-normal glucose levels [10]. Another study [11] confirmed that bone loss can be reversed when insulin is given.

A study [8-12] showed when insulin is used, bone-implant interface becomes similar to those of control group. So metabolic control is essential for osseointegration as hyperglycaemia delays healing but the amount of bone formed was not equal to diabetic groups.

Human studies

A prospective study [13] of 89 well-controlled type 2 diabetic patients with 178 dental implants placed in the mandible. Results revealed an early failure rate of 2.2% after implants were uncovered and a failure rate of 7.3% one year after implantation. Another study [14] from a meta-analysis of two implant systems placed in edentulous mandibles which revealed an early implant

failure rate of 3.2%, whereas late failures (from 45 months to 9.5 years) increased by between 5.2 and 5.4% .
Retrospective study with 215 implants placed in 40 diabetic patients, showed a survival rate of 85.6% after 6.5 years of functional use. The results obtained show a higher index of failures during the first year after placement of the prosthesis[15].

Type 1 diabetes
• Immune mediated
• Idiopathic
Type 2 diabetes
• Genetic defects of β cell function, insulin action
• Pancreatic disease
• Drug induced Corticosteroids, thiazide diuretics, phenytoin
• Viral infections Congenital rubella, mumps, coxsackie virus B
• Genetic syndromes Down's syndrome, klinefelter's syndrome, Turner's syndrome
• Excess endogenous production of hormonal antagonists to insulin

Table-1: Aetiological classification of Diabetes Mellitus

The five-year results of prospective study [16] done revealed a survival rate of 90% in continuation to the prospective study [13]. Data revealed that fasting plasma glucose and HbA_{1c} values at baseline and follow-up (when implants were uncovered), subject's age, baseline diabetic therapy, and smoking history were not statistically significant predictors of implant success or failure.

Tissue perfusion and micro vascular diseases have an important role in wound healing [17]. Since diabetes is associated with micro vascular changes, patients with diabetes have poor wound-healing potential. The healing process of hard and soft tissues in the diabetic patient is also delayed as a result of decreased protein metabolism.
Micro vascular alterations cause diminished immune response and reduction in bone remodelling process which might be a contributing factor to implant failure in diabetic patients [17-18]. Studies show increased failure rate after about one year suggesting that the risk for implant failure is associated with the uncovering of implants and during first year of functional loading i.e. placement of prosthesis on implant [15-18].
Level of evidence indicative of absolute and relative contraindications like diabetes for implant treatment due to systemic diseases is low [19]. Dental implant failure is low and there are no absolute contraindications to implant placement. Conditions that were found to be correlated with an increased risk of failure should be considered during treatment planning and factored into the informed consent process [20].
Study showed no evidence of diminished clinical success or significant early healing complications associated with implant therapy based on the glycaemic control levels of subjects with type 2 diabetes mellitus [21]. Successful dental implant osseointegration can be accomplished in subjects with diabetes with good metabolic control (serum glycaemic level and

haemoglobin A1c in normal range) in a similar manner as in subjects without diabetes [22].

Most of the articles revised resolve that, despite the higher risk of failure in diabetic patients, maintaining normal blood glucose levels along with other measures improves the implant survival rates in this patients [2].

Further studies are necessary in humans to determine the biological factors affecting osseointegration in diabetic patients.

Microvascular/neuropathic
Retinopathy
Nephropathy
Peripheral neuropathy
Autonomic neuropathy
Foot disease
Macrovascular
Myocardial ischaemia/infarction
Cerebro vascular disease
Peripheral arterial disease

Table-2: Complications of diabetes

Consideration for implant patients with diabetes

Systemic and rehabilitative factors are used in assessing the severity of diabetes and its complications, as well as the consideration for rehabilitation planning in these patients [23]. Integration of these factors by the dentist dictates whether as well as what type of implant-supported prosthesis should be preformed.

Systemic factors: type of diabetes, duration, sanative protocol, history of hypo/hyperglycaemia, haemoglobin A_{1C} levels, blood glucose levels, target organ involvement and history of delayed wound healing.

Rehabilitative factors: restoration type-removable v/s fixed, implant length, surgical protocol, implant location-mandible v/s maxilla, bone type and quality and bone augmentation.

Systemic factors

- Type of diabetes: Type1diabetes is difficult to control and because of its early onset has severe systemic complications. So operator must be careful when using dental implants in type1 diabetic patients.
- Disease duration: It is an important factor. Longer duration allows for more damage to accumulate systematically, in relation to the degree to which the disease has been controlled.[16]
- Sanative protocol: severity of disease can be seen by regimen needed to control ones disease. Diabetic patient treated by diet alone have a less severe disease than patients who must use hypoglycaemic medication. Diabetic patients requiring insulin have more chances of experiencing the most disease complications.
- History of hypoglycaemia and hyperglycaemia: It is important to record occurrences of hypo/hyperglycaemia as such events give a sign of low level of glucose balance if necessity of hospitalization is required.
- Haemoglobin $A1_C$ levels: Diabetic patients should maintain good glucose levels before starting implant rehabilitated prosthesis procedures. To measure the status of blood-glucose levels in the previous 6-8 weeks, we have to know the HbA1c values. A figure of less than 7% for HbA1c is considered a good level of

glycaemic control (the normal value for healthy individuals is 3.5 to 5.5% depending on the laboratory). In patients with poor or fair control of haemoglobin A_{1C} better disease control can be achieved by consulting Diabetologist/endocrinologist [23]. Successful dental implant osseointegration can be accomplished in subjects with diabetes with good metabolic control (serum glycaemic level and HbA1c in normal range) in a similar manner as in subjects without diabetes. It is therefore necessary to maintain good glycaemic control before and after surgery for successful osseo integration of implants [22].

Factors associated with increased mortality and morbidity in people with diabetes
• Duration of diabetes
• High glycated haemoglobin (HbA_{1c})
• Early age of onset of disease
• Protienuria
• Raised blood pressure
• obesity

Table-3: Factors associated with increased mortality and morbidity in people with diabetes

History of impaired wound healing

Previous histories of impaired healing after surgical procedures including oral surgeries are a good measure for this.

Rehabilitative factors:

- Restoration type: removable v/s fixed prosthesis: Failure of one implant in multiple implant supported fixed prosthesis leads to failure of entire prosthesis. Moreover fixed prosthetics require exact implant localization. Removable prosthesis is preferred in diabetic patient as implants placed in posterior jaw region are not perfect since bone availability and quality is less in diabetic patient.
- Implant length: Failures are seen in short implants. It is the same for diabetic patient as compared to general population [20,24].
- Surgical guide lines: Surgical guidelines are significant for treating implant patients with diabetes.

Pre-operative:

Antibiotics and chlorhexidine mouth washes improves the success rates for dental implants. The antibiotic of choice is amoxicillin (2 gram per 1 hour previously), In case of penicillin allergy, Clindamycin (600 mg per 1 hour previously), azithromycin or clarithromycin (500 mg per 1 hour previously), and first-generation cephalosporins (cephalexin or cefadroxil: 2 gr per 1 hour previously) can be used [25]. A first-generation cephalosporin is recommended, however, only if the patient has not had any anaphylactic allergic reaction to penicillin [26].

Use of 0.12% chlorhexidine mouthwash has shown a clear benefit by reducing the failure rates from 13.5% to 4.4% in type 2 diabetics, during a follow-up period of 36 months [2], so pre and post operative rinse with 0.12% chlorhexidine digluconate is recommended.

The use of antiseptic mouth rinses and oral-hygiene maintenance helps in achieving a successful dental implant osseointegration in subjects with diabetes [22].

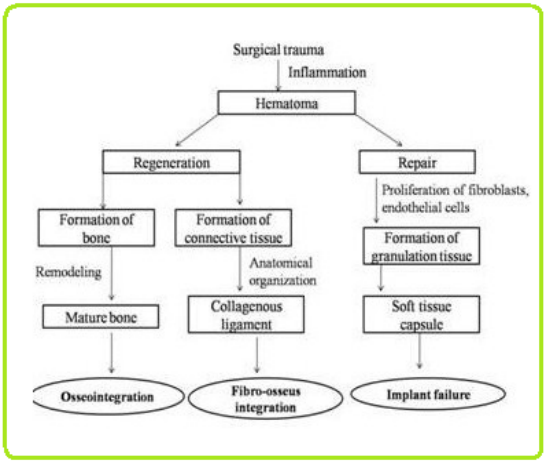

Figure-1: Mechanism of wound healing after implant placement

Post-operative

Vitamin supplements: Physiological doses of vitamin D (400-800 IU/day) and calcium (1500 mg/day) during post operative period should be prescribed.

Duration of Osseointegration

Recommended healing period is 6 months in maxilla and 4 months in mandible for normal patients, but in diabetic patients healing period should be increased by another 2 months for good osseointegration. Careful occlusal adjustment and examination for signs of occlusal overload is noted [26].

- Implant location: mandible versus maxilla
  Symphysis area of the mandible is the ideal location yielding the highest success rate. Success rates are higher in mandible and more if implants are located anteriorly [20, 27,28].
- Bone type and quality:
  Bone remodelling around implants in diabetic patients is slower and less effective so immediate loading of implants should be avoided in diabetic patients.
- Bone augmentation:
  Bone augmentation is not advised in diabetic patients although it is found in literature [29,30].

Conclusion

There is evidence that hyperglycaemia has a negative influence on bone formation and remodelling and reduces osseointegration of implants. Soft tissue is also affected by the micro vascular complications deriving from hyperglycaemia, vascularisation of the tissue is compromised, healing is delayed and wounds are more predisposed to infection. This entails an increase in the percentage of failures in the implant treatment of diabetic patients. The bibliography reviewed recommends good glycaemic control in the peri-operative period in order to improve the survival rates for implants in diabetics. 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. Overall, dental implant failure is low and there are no absolute contraindications to implant placement. Conditions that were found to be correlated with an increased risk of failure should be considered during treatment planning and factored into the informed consent process.

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