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DIABETES MELLITUS AND DENTAL IMPLANT THERAPY- A REVIEW.

Periodontology

Dr Jaya Agrawal	B.D.S Junior Resident III, Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, Lucknow, India.
Dr Anjani Kumar Pathak *	M.D.S Additional Professor, Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, Lucknow, India. *Corresponding Author
Dr Kumar Vikram	M.D.S Senior Resident Department of Dentistry,AIIMS Jodhpur.
Prof. (Dr) Nand Lal	M.D.S Professor & Head, Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, Lucknow, India.
Dr Kopal Goel	M.D.S Reader, Department of Prosthodontics, Sardar Patel Postgraduate Institute of Dental & Medical Sciences, Lucknow, India.

ABSTRACT

Dental implant is considered as the rehabilitative anchor in the present era of dentistry. The continuous upgradation in terms of implant design, augmented by newer technology and technique-driven strategic implant placement makes the surgery minimally invasive and shortens the treatment duration, thereby increasing the predictability of replacing missing teeth in partially and completely edentulous cases. However, certain medical conditions like Diabetes Mellitus is still viewed as a relative contraindication for dental implant therapy. Also, with the increasing prevalence of diabetes mellitus over the years, the need for a better inference is needed to rule out the controversy over efficacy and safety of dental implants in diabetics. Hence, this review summarizes the interlink between peri-implantitis and diabetes mellitus by assessing the recent evidences involving diabetic patients and incidences of peri-implantitis.

KEYWORDS

Diabetes mellitus, Dental implants, Peri-implantitis, Implant survival, Oral health.

INTRODUCTION

The present era of oral rehabilitative dentistry is dominated by the dental implants as they have become the foundation of simple as well as complex prosthetic treatments for completely or partially edentulous patients. This is more likely due to the enhancements in the design and surface characteristics of implant along with patient compliant surgical conduct. Higher predictability of implant-based treatment modality is greatly supported with its very high prospects of survival of about 94.6% and an average success rate of 89.7% over a decade.[1] The survival of implant majorly counts on propitious osseointegration upon its placement and any variation in this biological process may have an inimical end result. As an implant approaches its prosthetic phase, bone remodelling plays a vital role in response to the functional demands of the implant prosthesis and the bracing alveolar bone. Such vulnerability on this salient phenomenon of bone metabolism leads us to assess various risk factors, out of which poorly controlled Diabetes Mellitus is one of the most frequently encountered contraindications to dental implant therapy.

Diabetes Mellitus is an overt health issue of chronic metabolic disorder classified into two types- Insulin-dependent type 1 and Non-insulin dependent type 2. Type 1 is an autoimmune disease caused due to self-destruction of beta cells of islets of pancreas whereas type 2 is a lifestyle modified disease which occurs due to resistance developed at cellular level against secreted insulin. This burgeoning health disorder has grown predominantly worldwide from a prevalence rate of 150 million in 1980 to 450 million adults in 2017, with a predictable rise to 693 million by 2045.[2] It is associated with systemic complications such as microvascular and macrovascular diseases, increased susceptibility to infection and altered wound healing which raises the possibility of postsurgical complications following dental implant surgery. It is characterized as a risk factor for periodontal disease with Periodontitis being the sixth complication of diabetes.[3] Hyperglycaemic state is known to have multiple adverse effects at tissue level, causing decreased osteoblast proliferation, differentiation, reduced collagen turnover and osteoblast apoptosis, ultimately resulting in impaired bone metabolism.[4]

Being a complex infectious disease in nature, Periodontitis stems from the interplay of bacterial infection and the host response to it, further modified by genetic susceptibility, environmental and acquired risk factors. It is the most common oral infection in India with a prevalence rate of 66.2% in the 15 year age group, 89.2% in the 35-44 age group and 5-20% worldwide.[5] It is primarily a gram negative infection springing in rigorous inflammation, with a probable vascular spread of the microbiota and their virulent factors systemically.

The 6th European workshop of Periodontology introduced a broader term- Peri-implant diseases to include the analogous entities to gingivitis and periodontitis as peri-implant mucositis and peri-implantitis respectively. Both are biofilm-associated diseases affected by variable and non-variable local, systemic, and environmental factors.[6] Peri-implantitis includes changes in soft tissue like increased bleeding, pocket formation, pus discharge, and peri-implant mucosal recession along with loss of bone around the implant. Multiple studies suggest the prevalence of peri-implantitis to range from 1.4 to 53.3%.[7-9] It's early diagnosis and effectual treatment is essential to avert a loss in implant stability to have a successful implant rehabilitation.

A study found similarities between peri-implantitis and periodontitis on immunohistochemical and microbiological grounds.[10] Also, type 2 diabetics are highly prone to periodontitis when compared to non-diabetics.[11] Such correlative findings collectively imply a strong association between Diabetes Mellitus and the growing rate of peri-implantitis. According to another study, implant failure rate in diabetics is 2.75 times more than others, which is in contradiction to other studies suggesting no definitive relationship between the two.[12-13] Therefore, further insight is needed to have a better understanding regarding whether Diabetes Mellitus is tied-in with peri-implantitis from the available evidences in the reported studies.

EFFECT OF DIABETES ON ORAL HEALTH

Oral presentations of DM may be grouped into two: those which exert an effect on the hard tissues and the other on the soft tissues of the jaws. Chronic immunosuppression, impaired traumatic amelioration, and insufficient function of salivary glands predispose all the above-mentioned oral illustrations.[14] Many reviewed articles suggest "age" also as a potential influencer. Dorocka-Bobkowska *et al.* [15] in their study demonstrated an increased incidence of root caries, burning mouth syndrome, angular cheilitis, glossodynia and a diminishing salivary flow rate in the higher aged group, but no such incidence was seen amid the younger diabetic patients. Another study by Kaur [16] also showed a strong association of age along with gender in type 2 DM and tooth loss.

The various biological phenomena like savour, act of chewing and swallowing, assimilation, and preservation of oral mucosa are all determined by the role of salivary glands. Any disease or dysfunction

of these glands result in either changes in the composition or flow of saliva, leading to parched oral cavity and polydipsia, most commonly seen in DM. It has also been observed that greater levels of HbA1c and drug-induced xerostomia are linked to reduced salivation without an intermediary.[17] To overcome this, increased fluid consumption, alcohol free mouthwashes and artificial salivary fill-ins are recommended over a considerable period to bring down the microbial count of plaque and gingivitis.

Burning mouth syndrome is yet another unvarying affliction in the diabetic group presenting no objective signs or laboratory findings. It is believed that DM impairs the sensorimotor function resulting in severe oral discomfort. Thus, the patient finds it difficult to take a well-balanced diet, in turn worsening the diabetic status.

DIABETES AND EDENTULISM

Loe H stated periodontal disease as the sixth major complication of diabetes.[18] Thus, such individuals are always at a higher risk of becoming partially or completely edentulous. The relationship between the two is a bi-directional one.[19] Firstly, the risk of onset and severity of periodontitis in diabetics (especially Type 2 DM) is approximately three-fold more than the non-diabetics.[20] An increase in the HbA1c levels (> 9%) is associated with unreasonable loss of periodontal attachment, elevated pocket probing depths, residual pockets and enlarged, velvety-red bleeding gingival tissues.[21]

Secondly, severe periodontitis is associated with impaired glucose tolerance, impaired fasting glucose and DM than moderate periodontitis.[22] Also, increasing number of diabetes related complications like diabetic retinopathy, nephropathy, neuropathy, etc are seen in advanced periodontitis.[23]

No remarkable distinction is found in the subgingival microbiology of diabetics and non-diabetics.[24] The acuteness of periodontitis in diabetics can be contingent to variance in the feedback mechanisms of the host which are summarized in the figure 1.[25-27]

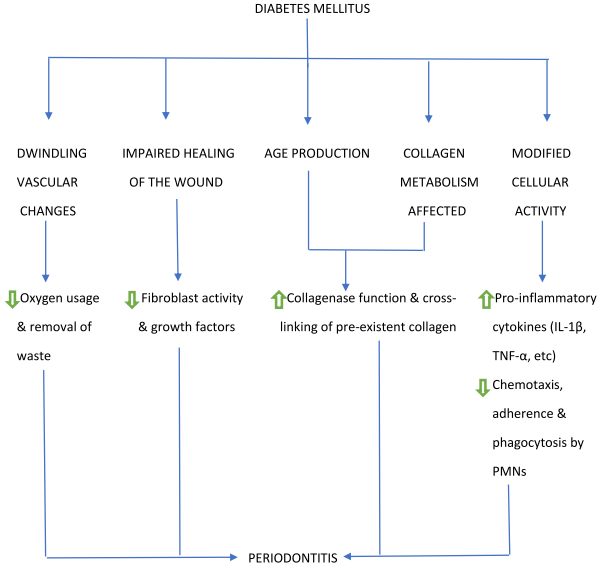

Figure 1: Various vascular, metabolic and immunological effects of hyperglycemia in diabetes mellitus and their association with periodontal disease progression. [25-27]

Apart from periodontitis, various other factors like xerostomia, dental caries, periapical or peri-radicular lesions and increased vulnerability to oral infections contribute to tooth extraction which gradually interferes with patient's daily dietary regimen, thus hampering the nutritional status and oral health of the individual.[28]

Tooth loss also has a physical as well as mental impact, as it becomes difficult for the patient to masticate, speak or socialize due to significant adverse qualitative changes. These reasons demand for an effectual treatment modality, where dental implants come into play.

DIABETES AND PERI-IMPLANT DISEASES

Dental implants as a successful treatment modality for diabetics is mainly dependent on the peri-implant tissue health and bone level. The ravaging effect on peri-implant tissues in diabetics is propelled by a similar mechanism of immune reaction seen in periodontitis.[29] Increase in the blood sugar level in Type-2 DM precipitates the genesis and accretion of advanced glycation end-products (AGEs) in surplus, which interfere with the fibroblast function thereby decreasing the production of matrix proteins and collagen metabolism.[30] The AGE-receptor activation in serum and GCF leads to the peri-implant bone loss and reduced bone turnover mediated by pro-inflammatory cytokines (IL-6, IL-1β and TNF-α).[31] Besides these predispositions, diabetic micro-angiopathy contributes to the poor vascularity of the flap, impaired healing, and higher chances of post-operative soft tissue complications.[32]

Many studies have been conducted to draw conclusions on the various clinical parameters like Plaque Index (PI), Probing Depth (PD), Bleeding on Probing (BOP), and peri-implant bone loss in Type 2 Diabetes Mellitus (HbA1c>6.5%), pre-diabetic (5.6-6.4%) and non-diabetic (4-5%) groups. Some of them portrayed a rise in all these parameters in the diabetic group. Few showed no statistically notable differences among the groups, but probing depths and marginal bone loss contrasted this as these along with the AGE levels were seen on a higher side in the diabetics.[29-35]

Various prospective studies illustrate a greater bone resorption and HbA1c levels in non-submerged implants than their counterparts whereas no link was established between diabetes mellitus and peri-implant bone loss in one of the studies.[36,37] One of the retrospective studies reveal positive outcomes like no bleeding on probing or probing depth and a marginal bone loss of of 0.3±0.1mm in T2DM.[38]

Finally, the systematic reviews with meta-analysis interpreted that diabetics are two times further inclined to acquire peri-implantitis while a cross-sectional study stated a considerable probability of 1.9 or 4.1% in T2DM to peri-implantitis.[39,40]

PREDICTORS OF IMPLANT SUCCESS

The failure and survival of implant is majorly influenced by the operator's deftly placement and meticulous treatment planning. But the presence of systemic medical conditions like Diabetes Mellitus can cause a setback in it. Numerous studies have been reported in the literature to describe the impact of Type 2 diabetes mellitus (T2DM) on implant osseointegration and survival.

The studies on implant survival comparing T2DM with a healthy control group revealed mixed results: 95.1 vs 97%, 97.2 vs 95% and 97 vs 98.8%, whereas those without a healthy control depicted 100-86%, 97.3 and 94.4% after 1 and 5 years and 91-88% after 5 years.[41-47] These findings are approximating the survival rates of healthy group except one which bespeaks a lower rate of 85.6% after 6 years, with nearly all implant failures in the first-year post loading of the prosthesis.[48] A recent study clearly stated that uncontrolled T2DM (HbA1c >8%) appears to have a bleak outcome on implant survival, thereby marking the pronounced effect of T2DM on the success rate of dental implants.[49]

Two prospective studies were taken into consideration to inquire into the influence of T2DM on osseointegration. Both the studies had the same inclusion criteria of HbA1c level, basing on which three groups were made: well-controlled (HbA1c 6.1-8%), moderately (HbA1c 8.1-10%) and poorly-controlled (HbA1c >10%), provided the normal value was ≤6%. The third group out of all, depicted a lesser implant stability in the earlier 0.5-1.5 months, but this fact gradually diminished as no evident difference was found between the groups after completion of a year.[6,50]

DISCUSSION

The prevalence of diabetes has increased over the years, mainly attributed to diet and lifestyle modifications due to the improving economic conditions in the developing world. Concurrently, increase in life expectancy of mankind necessitates improved treatment modalities and patient care. In that regard, implant supported prosthodontic management has become the mainstay of oral rehabilitation.

As already stated that peri-implantitis is analogous to periodontitis, an overabundance of pro-inflammatory cytokines like IL-6, IL-8, TNF-α and few chemokines such as monocyte chemotactic protein (MCP-1)

and C-C chemokine receptor CCR-2 and -4 have been detected in the histological examination of peri-implant vicinity in diabetics.[51]

Implant success is majorly influenced by the extent of osseointegration, which is usually compromised in Type 2 diabetics. Microangiopathy, a pronounced complication of diabetes mellitus, affects the blood clotting property, thereby hindering the healing process. There is a gradual decrease in the bone forming cells and a slight increase in the osteoclastic and fibroblastic activity around the implant, thus giving an outlook of "fibro-osseous integration". As a result, a slacker bone-implant junction can be noticed and healing maybe delayed, for instance not until six months in some cases.[13]

Nevertheless, implant is an excellent treatment option in well-controlled diabetics (HbA1c-6.1-8%), also in moderately and poorly-controlled groups only if the optimum blood sugar levels are achieved and the co-morbidities are eliminated, if any.[6]

CONCLUSION

Dental implants can be placed only in the healthy group of individuals was an age-old belief. Even the poorly-controlled diabetic patients can receive implants with meticulous treatment planning and constant glucose monitoring. With the advent of newer and better implant designs, less traumatic and advanced technology-guided precise implant placement techniques, implant-based treatment modalities continue to remain as the cornerstone in oral rehabilitative procedures. They have portrayed successful results in not only healthy patients, but also in the substandard medically compromised patients. Thus, dental implants are prudent and practical in Type 2 diabetic patients.

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