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Management of periodontal disease in patients with diabetes- good clinical practice guidelines: A joint statement by Indian Society of Periodontology and Research Society for the Study of Diabetes in India

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INTRODUCTION

Periodontitis is a chronic inflammatory disease triggered by bacteria, leading to the destruction of tooth-supporting apparatus, and finally, tooth loss. Diabetes mellitus (DM) is a heterogeneous syndrome with impaired glucose tolerance (IGT) and impaired lipid and carbohydrate metabolism. Chronic periodontal conditions, similar to any other infections, are caused by Gram-negative bacteria, and they not only tend to exacerbate insulin resistance in the body but also aggravate the systemic inflammatory condition in patients with diabetes. Dysregulated secretion of pro-inflammatory cytokines in periodontal disease causes their entry into the bloodstream, thereby affecting distant sites (tissues and organs). This perpetuated hyperglycemic state caused by periodontal inflammation is known to further worsen the glycemic status and to promote the associated

complications of diabetes in these patients. Periodontal therapy also has an effect on glycosylated hemoglobin (HbA1c) levels in the blood, thus improving the metabolic control of the patient.

Diabetes and periodontal diseases are both chronic, highly prevalent, coexistent, comorbid conditions in general population. Current scientific evidence suggests a bidirectional association between oral health and diabetes, and a mutual reciprocal increase in the risk, incidence, prevalence, progression, and severity has been documented for both diseases. Interprofessional collaboration between periodontists/dentists and diabetologists/physicians provides them an opportunity to render improvised, effective, and optimal patient care for the increasing number of such patients in daily clinical practice. Such collaborative clinical practices have a significant effect on improving oral health-related quality of life (OHRQoL) of diabetes patients. The oral healthcare team plays an important role in the identification of both prediabetes and undiagnosed DM patients, and the physicians need to be aware of periodontal diseases and their implications for glycemic control and complications in people with diabetes.

This paper presents a joint statement put forth by the Indian Society of Periodontology (ISP) and the Research Society for the Study of Diabetes in India (RSSDI); this statement has been developed to provide Good Clinical Practice Guidelines for the Management of Periodontal Diseases in Patients with Diabetes, based on the contemporary available evidence and expert consensus statements about the relationship between these two important diseases.

The paper has been divided into five sections. Section A deals with the broad understanding of DM, disease burden, medical management, and essential modifications to dental/periodontal therapy that may be required from a diabetologist's perspective. This section has been collectively co-authored by diabetologists who are members of the RSSDI and ISP. Sections B–D deal with periodontal diseases, bidirectional relationship between diabetes and periodontal diseases, and treatment of periodontal diseases in diabetes patients, respectively. The expert group members of each section were provided with a set of relevant questions from the above-mentioned domains, and the consensus answers along with the available evidence have been included in the paper as recommendations to the respective sections for clinical implementation.

SECTION A - DIABETES: AN OVERVIEW

Q1: What is the underlying inflammatory pathogenesis of diabetes?
There is a bidirectional interrelationship between diabetes and many other inflammatory conditions such as periodontal diseases owing to several pathogenetic mechanisms, with inflammation being the most important one. The potential mechanistic links underlying this relationship are a triad of (a) bacteremia, (b) inflammatory response, and (c) immune response. The three pathogenetic mechanisms are intricately linked and pivotal in the development of these chronic diseases.[1]

It has been well established that "glucocentricity" and "lipocentricity" both contribute to insulin resistance and therefore the development of diabetes. Obesity is a leading cause of insulin resistance, typically seen in type 2 DM. Adipocytes, or cells once assumed to be only for fat storage (thrifty phenotype hypothesis of James Neel and Barker hypothesis of David Barker, which suggests obesity in the later life of fetuses with prenatal malnutrition),[2] have metabolically active involvement in the production of adipokines, which modulate insulin levels, thereby causing more insulin resistance and resulting in diabetes. There are two types of adipokines:

1. Pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α), interleukin 6 (IL-6), and C-reactive protein (CRP) are increasingly synthesized in metabolic disorders. CRP upregulates the pro-inflammatory action of plasminogen activator inhibitor 1 and increases atheroma formation
2. Leptin, adiponectin, and visfatin: the first two adipokines are insulin-sensitizing hormones and exert a protective action, while the third one is insulin mimetic. Adiponectin particularly downregulates TNF-α while upregulating anti-inflammatory IL-10 and downregulating the conversion of monocytes to foam cells. The presence of other adipokines such as resistin has also been noted, but its role is not clearly defined.[3]

Changes in the immune cell function are observed because of hyperlipidemia. Hyperlipidemia is associated with the upregulation of pro-inflammatory cytokines from monocytes and polymorphonuclear leukocytes (PMNs). While IL-1β causes an increase in prostaglandins and matrix metalloproteinase (MMP), decrease in collagen synthesis, and upregulation of T- and B-lymphocytes, TNF-α is associated with increased cellular apoptosis, bone resorption, MMP, IL-6, and intercellular adhesion molecule (ICAM). In addition, there is downregulation of growth factors from macrophages as observed.[4]

Cytokines further effect lipid metabolism by modifying the hypothalamic–pituitary–adrenal (HPA) axis, thereby increasing the production of the adrenocorticotropic hormones, such as cortisol, adrenaline, noradrenaline, and glucagon.

There is increased expression of low-density lipoproteins (LDLs), triglycerides, and polyunsaturated (omega-6) fatty acids but decreased 6-desaturase enzyme activity. It is caused by the disturbance in the membrane proteins and phospholipid bilayer of the cell membrane, resulting in impaired cellular function/homeostasis and healing.[5] Hyperglycemia and hyperlipidemia both lead to the formation of phenotypes of hyperresponsive monocytes to lipopolysaccharides (LPSs). Increased expression of monocyte chemoattractant protein 1 (MCP-1) can lead to tissue breakdown, causing impaired wound healing.

Decreased nicotinamide adenine dinucleotide phosphatase (NADPH) production leads to compromised neutrophil function (decreased NADPH oxidase leads to decreased respiratory burst in the neutrophils during phagocytosis). Downregulation of glucose-6-phosphate dehydrogenase production in the neutrophils, lymphocytes, and macrophages results in decreased phagocytosis, bactericidal activity, and superoxide production. Decreased glutamine utilization causes reduction in glutamate and glutathione synthesis from neutrophils, which have antioxidant functions.

Increased intra-nuclear factor (NF)-KB binding, reduced IKBα level, upregulated IKB kinase activity, and higher TNF-α mRNA expression in the mononuclear cells are pro-inflammatory changes triggered by hyperglycemia. It also manifests as hyperreactive peripheral blood neutrophils.[6]

Hyperproduction of reactive oxygen species (ROS) and reactive nitrogen species is associated with hyperglycemia. Oxidation of circulating LDL leads to increased oxidative stress, causing cellular adhesion, increased production of cytokines, and growth factors, resulting in the stimulation of smooth muscles, increase in vessel thickness, and enhanced atheroma formation.

Role of advanced glycation end products

The production of collagen and glycosaminoglycans is reduced in high-glucose environments (stabilized Amadori products). Collagen produced under such circumstances is susceptible to rapid degradation by MMPs, which affects bone collagen turnover. This reduces osteoblastic differentiation and extracellular matrix production. Advanced glycation end product (AGE)-modified collagen accumulates in the blood vessel wall and consequently narrows the lumen with circulating LDL cross-linking to the modified collagen, resulting in atheroma formation, underlying further macrovascular complications.[7]

1. In diabetes, the expression of receptor for AGEs (RAGE) is upregulated on the surface of smooth muscle cells, endothelial cells, neurons, macrophages, and monocytes.[8] The binding of AGEs to RAGE leads to increased ICAM-1, endothelial leukocyte adhesion molecule 1, and vascular cell adhesion molecule 1, which help bind activated monocytes and migrate under the intima layer of the vasculature. This aids in the ingestion of LDL in an oxidized state to become foam cells characteristic of an atheromatous plaque. The altered phenotype of monocyte–macrophage leads to increased production of IL-1, TNF-α, platelet-derived growth factor, and insulin-like growth factor, contributing to chronic inflammation
2. AGEs are associated with increased expression of vascular endothelial growth factor instrumental in microvascular complications
3. There is an increased production of pro-apoptotic factors such as ROS, TNF-α, and AGEs.[9]

Q2: What is the burden of diabetes – Globally and locally?

Interestingly, the concept of "Burden of disease" was developed in the 1990s by the Harvard School of Public Health, the World Bank, and the World Health Organization (WHO). This term was used to describe the death and loss of health due to disease, injury, and risk factors worldwide.[10]

Importance of the concept

Understanding the burden of disease state is a key to improve the global public health and impact the national and international health policies related to the attainment of the health-related Millennium Development Goals.

With this background, the burden of diabetes globally and in India, as per the latest International Diabetes Federation Atlas, 9th Edition, 2019,[11] is described here.

Burden of the disease globally

In total, 463 million adults are currently living with diabetes, and this number is projected to reach 578 million by 2030 and to 700 million by 2045.

1. This number has tripled since 2000, when it was 151 million. Currently, 9.3% of the world's total population of adults aged between 20 and 79 years are afflicted
2. Diabetes led to 4.2 million deaths in 2019
3. One in five people above 65 years old have diabetes
4. One in 2 (232 million) people with diabetes remain undiagnosed
5. Its prevalence is higher in urban (10.8%) than in rural (7.2%) areas and in high-income countries (10.4%) than in low-income countries (4.0%)

6. Diabetes caused a financial burden of at least USD 760 billion in healthcare in 2019, which is 10% of the total spending on adults. It is projected that the expenditure will reach USD 825 billion by 2030 and USD 845 billion by 2045. This represents an increase of 8.6% and 11.2%, respectively.

Similarly, the burden of the disease locally (India) is as follows: India ranks second in the largest number of adults and children with diabetes worldwide. The total number of people with diabetes in adults is 77.0 (62.4–96.4) million.

1. Of them, the number of people with undiagnosed diabetes is 43.9 (35.5–54.9) million
2. One in six adults with diabetes in the world belongs to India
3. The prevalence of diabetes in 2016 was highest in Tamil Nadu, Kerala, and Delhi, followed by Punjab, Goa, and Karnataka. The most important risk factor was overweight, with 36% being attributed to the global average of 19%[12]
4. There were 1.3 million deaths due to diabetes in South East Asia Region
5. The total diabetes-related health expenditure in the South East Asia Region was USD 8.1 billion in 2019. In India, this accounts for 87.9% of adults with diabetes in the South East Asia Region, and USD 92 was spent per person in 2019, whereas in the USA, diabetes-related expenditure per person was estimated to be USD 1190.

Reviewing the burden of the disease at the global and local levels, it is not only the prevalence but also the trend of increasing incidence that is disturbing.

Q3: (a) What are the standard diagnostic criteria of diabetes?

The diagnostic criteria for type 1 and type 2 DM are based on a multitude of blood parameters, namely plasma glucose criteria, either fasting plasma glucose (FPG) levels or 2-h plasma postprandial glucose levels, during a 75-g oral glucose tolerance test (OGTT), or more recent HbA1c test, which reflect the average plasma glucose concentration over the previous 8–12 weeks.[13,14] The International Expert Committee Report recommends a cutoff of ≥6.5% for HbA1c for diagnosing diabetes as an alternative to FPG (≥7.0 mmol/L or ≥126 mg/dL).[15]

In general, HbA1c testing provides salient advantages over other estimations such as FPG and OGTT, such as relative ease of conduct, correlation with secondary vascular complications in susceptible individuals, and more stable measurements of blood glucose, in general.[14-17] However, the test is most accurate with population-specific cutoffs regarding the sensitivity and specificity of HbA1c estimation, owing to ethnic differences.[18,19] In several countries including India, the HbA1c predictive accuracy for diabetes has been demonstrated to be inadequate, with a lack of consensus on a suitable cutoff point of HbA1c for diagnosing diabetes in this high-risk population.[20] Furthermore, the standardization of measurement techniques and laboratories, along with the relatively higher cost of HbA1c estimation, cannot be overlooked in the Indian context.[21] Keeping these considerations in mind, the panel expressed concerns about using HbA1c as the sole criterion for the diagnosis of diabetes, particularly in resource-constraint settings. Therefore, a combination of HbA1c and FPG was considered a better strategy for the identification and diagnosis of individuals with DM. The panel suggested HbA1c ≥6.5% as the optimal level for the diagnosis of diabetes in Indian patients and emphasized that HbA1c may be used in settings where an appropriate standardized method is available.[22]

The current RSSDI-Endocrine Society of India (ESI) joint clinical practice recommendations for the diagnosis of prediabetes/diabetes are as follows.

Diagnosis of diabetes: Recommendations

Recommended care

1. Prediabetes can be diagnosed with any of the following criteria
    1. Impaired fasting glucose: FPG 100–125 mg/dL or
    2. IGT: 2-h plasma glucose (2-h PG) in 140–199 mg/dL during 75-g OGTT or
    3. HbA1c ≥5.7%–6.4%.
2. Diabetes can be diagnosed with any of the following criteria
    1. FPG ≥126 mg/dL (FPG is defined as the amount of glucose estimated after no caloric intake for at least 8–12 h) or
    2. FPG ≥126 mg/dL and/or 2-h PG ≥200 mg/dL in 75-g OGTT
    3. HbA1c ≥6.5% (using a method that is certified by National Glycohemoglobin Standardization Program [NGSP]. For more on HbA1c and NGSP, please visit http://www.ngsp.org/index) or
    4. Random plasma glucose ≥200 mg/dL in the presence of classical diabetes symptoms.

Asymptomatic individuals with a single abnormal test should have the test repeated to confirm the diagnosis unless the result is unequivocally abnormal.

Limited care

Diabetes can be diagnosed with any of the following criteria:

1. FPG ≥126 mg/dL (FPG is defined as the amount of glucose estimated after no caloric intake for at least 8–12 h) or
2. FPG ≥126 mg/dL and/or 2-h PG ≥200 mg/dL using 75-g OGTT or
3. Random plasma glucose ≥200 mg/dL in the presence of classical diabetes symptoms.

Asymptomatic individuals with a single abnormal test should have the test repeated to confirm the diagnosis unless the result is unequivocally abnormal.

Note
1. Estimation of HbA1c should be performed using the NGSP standardized method
2. Capillary glucose estimation methods are not recommended for diagnosis
3. Venous plasma was used to estimate glucose
4. Plasma must be separated soon after collection of blood because the blood glucose levels drop by 5%–8% hourly if whole blood is stored at room temperature.

Q3: (b) What point-of-care testing would one recommend for screening of diabetes in a dental clinic?
1. Screening for diabetes by determining random capillary blood glucose in the clinic may be performed in a quick and efficient manner with the help of a glucose meter with reasonable reliability
2. An alternative is the point-of-care HbA1c testing using an NGSP-approved HbA1c analyzer for a clinical setting at a dental clinic for screening purposes or diagnosing diabetes, albeit more expensive and resource exhaustive (HbA1c reader, kits, and trained personnel).

Based on the recommended criteria, the patient may be diagnosed with prediabetes/diabetes and may be further advised to seek an expert opinion on the same along with detailed laboratory testing.

Q4: Common medications and their peak effect times when the chances of induced hypoglycemia would be maximum. This question implies what are the peak times (based on medications) that should be avoided for any stress-inducing dental procedures
In general, procedures may be scheduled in the morning for patients with diabetes, as the endogenous cortisol levels are higher at that time, rendering a lower risk of hypoglycemia in these patients. For patients on short- and/or long-acting insulin therapy to lower the risk of hypoglycemia, it is important to schedule dental procedures in such a way that the operative period does not coincide with the peak insulin activity of the drug. It should be confirmed that the patient has had a normal diet before the appointment and has taken all prescribed medications. If a procedure is planned with the expectation that the patient will alter normal eating habits ahead of time (e.g., conscious sedation), diabetes medications and dosing regimens may be modified by consulting the patient's physician or the treating medical doctor. Patients with well-controlled diabetes may be managed conventionally for most surgical procedures. If the patient's oral intake will be affected after oral or dental surgery, then a plan to balance food intake and antidiabetic medications should be established in advance in consultation with the patient's consulting physician or the treating medical doctor.

Common medications such as sulfonylureas, meglitinides, and their combinations and insulin are associated with a higher risk of hypoglycemia in patients with diabetes. The occurrence of hypoglycemia due to these groups of drugs may be irrespective of their peak action profile and depends on several other factors. Sulfonylureas (glibenclamide, glimepiride, and glipizide) trigger insulin production and may induce hypoglycemia in a preoperative, fasting patient.[23] If a patient has mistakenly taken a sulfonylurea on the day of surgery, the operation may still be completed, with careful glucose monitoring and intravenous dextrose, as required.

The details of the major drugs that cause hypoglycemia are listed in Tables 1 and 2.[24,25]

Q5: How to deal with inadvertent hypoglycemic episodes in a patient in a dental clinic? How does one make a diagnosis and what is the line of management?
The most frequently occurring adverse event among patients with diabetes on medications in a dental office is a hypoglycemic episode.[26] Hypoglycemia is a condition in which blood glucose levels drop below 70 mg/dL. Untreated hypoglycemia may be life-threatening.

Several situations may lead to hypoglycemia:
1. Insulin or other antidiabetic medications have the potential to cause hypoglycemia
2. Disruption in food intake due to changes in schedule (timing of dental appointment, illness/nausea, vomiting, diarrhea, skipping, delaying a meal, etc.)
3. Drinking excessive alcohol for the amount of food being eaten
4. Unexpected/unplanned increase in physical activity.

Although patients with diabetes usually recognize signs and symptoms of hypoglycemia and self-intervene at the earliest opportunity, the staff should be trained to recognize the signs and treat patients with

hypoglycemia[25] [Table 3]. A glucose meter in the dentists' clinic is a useful piece of equipment, and adequate training should be provided to the personnel to test glucose levels when encountering certain patients with a history of frequent hypoglycemia or even at the time of symptoms of hypoglycemia.

The current RSSDI-ESI joint clinical practice recommendations for the management of hypoglycemia are as follows.[22]

Recommended care

1. Risk of hypoglycemia should be assessed at every visit in patients with type 2 diabetes using questionnaires
2. Patients should be well educated and informed regarding the following:
   i. Symptoms, causes, and risks associated with hypoglycemia
   ii. Use of self-monitoring blood glucose (SMBG) tools with frequent monitoring, especially in patients taking insulin
   iii. Insulin dose adjustment considering blood glucose values
3. Strict monitoring of hypoglycemic episodes is recommended for patients taking insulin, sulfonylureas, or meglitinides either alone or in combination
4. Modern insulin or modern sulfonylurea should be used instead of the respective traditional drugs in patients with a high risk of hypoglycemia
5. Oral glucose (15–20 g) is preferred in conscious hypoglycemic patients (glucose alert value of <70 mg/dL). Repeat the treatment, if SMBG shows continued hypoglycemia after 15 min. Patients should consume a meal or snack once SMBG returns to normal, to prevent recurrence of hypoglycemia
6. Intramuscular glucagon or intravenous glucose is preferred for unconscious patients or patients with clinically significant hypoglycemia (glucose alert value of <54 mg/dL). Repeat the intramuscular or subcutaneous glucagon dose of 0.5 mg if there is no symptomatic improvement
7. Glucagon to be avoided in patients with sulfonylurea-induced hypoglycemia
8. Treatment should be modified in the event of hypoglycemia occurring repeatedly at a particular time of the day or in the event of hypoglycemia unawareness
9. Hypoglycemia occurring in the setting of advanced kidney disease (chronic kidney disease stage 4 or 5) requires relatively longer observation to avoid recurrence even long after initial corrective measures are taken.

Limited care

1. All patients with a risk of hypoglycemia should be enquired about symptomatic and asymptomatic hypoglycemia at each visit
2. Patients, along with their family members, should be well educated about the identification and management of hypoglycemia, especially night-time hypoglycemia
3. Hypoglycemia should be strictly managed and monitored in special situations such as elderly, pregnancy, fasting, and metabolic disorders.

Q6: What is the standard protocol for the follow-up of patients with diabetes with a diabetologist and a dentist?

For a patient with diabetes, follow-up with a diabetologist should be performed as per the suggested timeframe given by the consulting physician/treating medical doctor and/or dentist, in case of a minor, uneventful, dental procedure.

In case of any hypoglycemia or any other event during the dental procedure, the consulting physician/treating medical doctor should be consulted or informed of the same at the earliest opportunity, and follow-up should be within the timeframe suggested by the consulting physician/treating medical doctor.

It is suggested to check the blood sugar level using a glucose meter in case of symptoms of hypoglycemia, as possible, and 15 g of carbohydrate-like glucose gels, tablets, or powder should be administered orally and along with 20–50 mL of 50% dextrose solution intravenously until the sugars are stable and increasing again.

In case of a major dental procedure in a patient with diabetes, under moderate or poor control, follow-up with the consulting physician/treating medical doctor or dentist should be performed within 2–4 weeks.

Q7: What suggestions can be provided by a diabetologist to a dental practitioner for managing diabetes patients in a dental clinic taking into consideration the diabetic status and the medical management profile?

Patients with diabetes should be counseled about their increased risk for gingivitis and periodontitis and also be informed that if they have periodontitis, their glycemic control may be difficult to achieve while increasing the risk of microvascular and macrovascular complications, as the relationship between diabetes and periodontal disease is bidirectional.

A thorough review of the patient's medical history should be undertaken, including the type of diabetes, duration of diabetes, presence of any complications, antidiabetic therapy, and concomitant drugs, including anticoagulant/antiplatelet drugs, antihypertensive drugs, or lipid-lowering drugs.[22] The patient should also be asked about how well their diabetes is controlled, how often they check blood sugars, and when was the last time their blood glucose level was checked and requesting the patient to bring a copy of the most recent HbA1c test. They should also be asked how often they see their doctor for their diabetes and when was the last visit for the same. The patient should be asked about frequent fluctuations in blood sugar levels and whether they have frequent episodes of low or high sugar levels or whether they feel disoriented, agitated, or anxious for no apparent reason.[27]

Patients with a diagnosis of diabetes of any form should undergo a thorough oral examination, including a comprehensive periodontal evaluation, to include a full-mouth pocket chart, and bleeding scores, if indicated by periodontal screening. Patients with diabetes who are diagnosed with gingivitis (early and reversible sign of periodontal disease) should receive oral hygiene instruction, education, and preventive care regimen by the dentist and be monitored regularly for any subsequent periodontal tissue changes. Patients with diabetes presenting with any acute oral/periodontal infections require prompt oral/periodontal care. Irrespective of the glycemic status, nonsurgical periodontal therapy (NSPT) should be provided as this will contribute to improved glycemic control. For patients with diabetes who are poorly or marginally controlled, dentists should exercise caution and clinical judgment while treating them. Elective dental treatment may be delayed until the patient's glycemic control is stable or optimal. Surgical periodontal and implant therapy is not indicated in patients with diabetes who are poorly or moderately controlled. In well-controlled patients, surgical intervention results are equivalent to those of patients without diabetes. Attention should be paid to:

1. Patients with poorly controlled diabetes who have an increased risk of postoperative infections
2. For patients managed with insulin or sulfonylureas, the physician should be consulted about the timing of a planned procedure and a possible change in dosage of therapy to reduce the potential risk of intraoperative hypoglycemia.

Coordination with the patient's physician or treating medical doctor may be necessary to determine the patient's health status and whether planned dental treatment can be safely and effectively accomplished. It is also recommended that the laboratory test results are shared or made available upon the dentist's request. In addition, dentists should be aware of any diabetes complication of relevance to the individual patient before the dental procedures. The physician may need to adjust the patient's diabetes medications to ensure sustained metabolic control in the perioperative period.

In general, procedures may be scheduled in the morning for patients with diabetes as the endogenous cortisol levels are higher, thereby lowering the risk of hypoglycemia in these patients.[25,26] It is important to schedule procedures for patients on short- and/or long-acting insulin therapy such that the results do not coincide with peak insulin activity, thereby reducing the risk of hypoglycemia. Importantly, it should be confirmed that the patient has had a normal diet before the appointment and has taken all prescribed medications. If a procedure is planned with the expectation that the patient will alter normal eating habits ahead of time (e.g., conscious sedation), diabetes medications may be modified by consulting the patient's physician or treating medical doctor. Patients with well-controlled diabetes may be managed conventionally for most surgical procedures. If the patient's oral intake is affected after oral or dental surgery, a plan to balance food intake and antidiabetic medications should be established in advance. Patients with diabetes and extensive tooth loss should be encouraged to pursue dental rehabilitation to restore adequate mastication for optimal nutrition.

Patients with diabetes should also be evaluated for other potential oral complications, such as mouth sores, dry mouth, burning sensation in the mouth, candidal infection, and dental caries. In children and adolescents with diabetes, annual oral screening for early signs of periodontal involvement and dental caries is recommended as early as possible.

Oral health education should be imparted to all patients with diabetes, with individualized advice on relevant risk factors and a tailored oral hygiene regimen, including twice-daily brushing and interdental cleaning. In some cases, the use of adjunctive chemical plaque control may be appropriate.[28]

To provide a perspective to the RSSDI-ESI clinical practice recommendations, it is necessary that for patients who are suspected to have prediabetes/diabetes or have diabetes or are newly diagnosed patients with diabetes, the dentist should collaborate with the consulting physician or a qualified expert for the medical management of diabetes during the planned dental procedure.[22,29] Patients who present to the dental clinic with an unknown status of diabetes but have risk factors for type 2 diabetes should be counseled for the same and referred to the physician for undertaking adequate screening, diagnosis, and management of diabetes.

REFERENCES

1. Grover HS, Luthra S. Molecular mechanisms involved in the bidirectional relationship between diabetes mellitus and periodontal disease. J Indian Soc Periodontol 2013;17:292-301.
2. Hales CN, Barker DJ. The Thrifty phenotype hypothesis. Br Med Bull 2001;60:5-20.
3. Lau DC, Dhillon B, Yan H, Szmitko PE, Verma S. Adipokines: Molecular links between obesity and atheroslcerosis. Am J Physiol Heart Circ Physiol 2005;288:H2031-41.
4. Iacopino AM, Cutler CW. Pathophysiological relationships between periodontitis and systemic disease: Recent concepts involving serum lipids. J Periodontol 2000;71:1375-84.
5. Kim DK, Escalante DA, Garber AJ. Prevention of atherosclerosis in diabetes: Emphasis on treatment for the abnormal lipoprotein metabolism of diabetes. Clin Ther 1993;15:766-78.
6. Aljada A, Friedman J, Ghanim H, Mohanty P, Hofmeyer D, Chaudhuri A, *et al*. Glucose ingestion induces an increase in intranuclear nuclear factor kappaB, a fall in cellular inhibitor kappaB, and an increase in tumor necrosis factor alpha messenger RNA by mononuclear cells in healthy human subjects. Metabolism 2006;55:1177-85.
7. Monnier VM, Glomb M, Elgawish A, Sell DR. The mechanism of collagen cross-linking in diabetes: A puzzle nearing resolution. Diabetes 1996;45 Suppl 3:S67-72.
8. Schmidt AM, Hori O, Cao R, Yan SD, Brett J, Wautier JL, *et al*. RAGE: A novel cellular receptor for advanced glycation end products. Diabetes 1996;45 Suppl 3:S77-80.
9. Moller DE. Potential role of TNF-alpha in the pathogenesis of insulin resistance and type 2 diabetes. Trends Endocrinol Metab 2000;11:212-7.
10. Hessel F. Burden of disease. In: Kirch W, editor. Encyclopedia of Public Health. Dordrecht: Springer; 2008. Available from: https://doi.org/10.1007/978-1-4020-5614-7_297. [Last accessed on 2020 Sep 29].
11. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, *et al*. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract 2019;157:107843.
12. Indian Council of Medical Research, Public Health Foundation of India, and Institute for Health Metric and Evaluation, India: Health of the Nation's States – The India State- Level Disease Burden Initiative. New Delhi, India: Indian Council of Medical Research, Public Health Foundation of India, and Institute for Health Metric and Evaluation; 2017.
13. American Diabetes Association. 2. Classification and Diagnosis of Diabetes: *Standards of Medical Care in Diabetes-2019*. Diabetes Care 2019;42:S13-28.
14. Nguyen KA, Peer N, de Villiers A, Mukasa B, Matsha TE, Mills EJ, *et al*. Glycated haemoglobin threshold for dysglycaemia screening, and application to metabolic syndrome diagnosis in HIV-infected Africans. PLoS One 2019;14:e0211483.
15. International Expert Committee. International Expert Committee report on the role of the A1C assay in the diagnosis of diabetes. Diabetes Care 2009;32:1327-34.
16. Hasslacher C, Kulozik F, Platten I. Glycated albumin and HbA1c as predictors of mortality and vascular complications in type 2 diabetes patients with normal and moderately impaired renal function: 5-year results from a 380 patient cohort. J Diabetes Res Clin Metab 2014;3:9.
17. Lauritzen T, Sandbaek A, Skriver MV, Borch-Johnsen K. HbA1c and cardiovascular risk score identify people who may benefit from preventive interventions: A 7 year follow-up of a high-risk screening programme for diabetes in primary care (ADDITION), Denmark. Diabetologia 2011;54:1318-26.
18. Lim WY, Ma S, Heng D, Tai ES, Khoo CM, Loh TP. Screening for diabetes with HbA1c: Test performance of HbA1c compared to fasting plasma glucose among Chinese, Malay and Indian community residents in Singapore. Sci Rep 2018;8:12419.
19. Guo F, Moellering DR, Garvey WT. Use of HbA1c for diagnoses of diabetes and prediabetes: Comparison with diagnoses based on fasting and 2-hr glucose values and effects of gender, race, and age. Metab Syndr Relat Disord 2014;12:258-68.
20. Prakaschandra R, Naidoo DP. Fasting plasma glucose and the HbA1c are not optimal screening modalities for the diagnosis of new diabetes in previously undiagnosed Asian Indian community participants. Ethn Dis 2018;28:19-24.
21. Radhakrishna P, Vinod KV, Sujiv A, Swaminathan RP. Comparison of hemoglobin A_{1c} with fasting and 2-h plasma glucose tests for diagnosis of diabetes and prediabetes among high-risk South Indians. Indian J Endocrinol Metab 2018;22:50-6.
22. Chawla R, Madhu SV, Makkar BM, Ghosh S, Saboo B, Kalra S, *et al*. RSSDI-ESI Clinical Practice Recommendations for the Management of Type 2 Diabetes Mellitus 2020. Indian J Endocrinol Metab 2020;24:1-22.
23. Groop LC. Sulfonylureas in NIDDM. Diabetes Care 1992;15:737-54.
24. Cosson E, Catargi B, Cheisson G, Jacqueminet S, Ichai C, Leguerrier AM, *et al*. Practical management of diabetes patients before, during and after surgery: A joint French Diabetology and Anaesthesiology Position Statement. Diabetes Metab 2018;44:200-16.
25. McKenna SJ. Dental management of patients with diabetes. Dent Clin North Am 2006;50:591-606, vii.
26. Lalla RV, D'Ambrosio JA. Dental management considerations for the patient with diabetes mellitus. J Am Dent Assoc 2001;132:1425-32.
27. Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F, *et al*. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International Diabetes Federation and the European Federation of Periodontology. Diabetes Res Clin Pract 2018;137:231-41.
28. Rees TD. Endocrine and metabolic disorders. In: Patton LL, Glick M, editors. The ADA Practical Guide to Patients with Medical Conditions. 2nd ed. Hoboken, NJ: John Wiley & Sons, Inc.; 2016. p. 71-99.
29. Lamster IB, Lalla E, Borgnakke WS, Taylor GW. The relationship between oral health and diabetes mellitus. J Am Dent Assoc 2008;139 Suppl: 19S-24S.

SECTION B: PERIODONTAL DISEASES

Q8: What is the role of inflammation in the pathogenesis of periodontal diseases?

The human oral cavity has a significant and evolving load of microbial species. The interactions between the host and microbial communities determine the severity of the disease. Periodontal diseases are generally caused by the overgrowth of commensal organisms, but not by exogenous pathogens. The immune mechanisms constantly adapt to rapidly evolving microorganisms to preserve homeostasis to maintain the ecological balance of commensal organisms.[1,2]

The pathogenesis of periodontal diseases is mediated by the inflammatory response to bacteria in dental biofilms. Specific microorganisms are reported to be associated with the progressive forms of the disease. These microorganisms are also present in individuals with no evidence of disease progression. This may indicate that disease progression is not related to the presence of bacteria alone, but the net effect of the immune response and the inflammatory processes plays an important role in this process. Patient susceptibility depends on the regulation of immune–inflammatory mechanisms and is modified by environmental factors.[3,4]

Diagnosis of periodontal disease

1. Several classifications of periodontal diseases have been proposed, and the recent classification proposed by the European Federation of Periodontology and the American Academy of Periodontology jointly has adopted the identification of the disease process and its severity based on clinical features. Clinical features such as bleeding on probing (BOP) and changes in color, position, size, surface texture, and consistency of the gingival tissues are the strongest lines of evidence indicative of inflammation as the principal feature in the pathogenesis of periodontal diseases. These features increase in severity if left unattended and lead to further deterioration of the condition by causing destruction in the supporting periodontal structures.

Clinical presentation and correlation

The initial inflammation in the periodontal tissues is a state of physiological defense mechanism against microbial etiology.[5] All components of the immune system, such as inflammation, resolution, and healing, act in harmony to protect the periodontium. It is important to bear in mind that as the lesion progresses, the preceding pathways still function.[6,7]

Inflammatory responses in the periodontium

Inflammatory responses are induced by the subgingival microbiota (i.e., microbial virulence factors) and from the host immune–inflammatory response.

Microbial virulence factors

Bacterial virulence factors initiate and propagate inflammation. These include a potent leukotoxin, which can destroy host immune cells such as PMNs, fimbrial adhesins, LPS, capsule, collagenase, and trypsin-like enzymes.[1]

Host-derived inflammatory mediators

The excessive and dysregulated production of inflammatory mediators and destructive enzymes in response to subgingival plaque bacteria causes majority of tissue damage in periodontitis. Multiple host defense mechanisms, including neutrophil migration, complement activation and antibody production cytokines, host-derived chemokines, prostaglandins (PGs) and TNF-α, act together to eliminate the periodontal infection.[8]

Destruction of periodontal tissues

Destruction of the bone

The concentration of inflammatory mediators in the gingival tissues must be sufficient to activate the pathways that lead to bone resorption along with the penetration of inflammatory mediators to be within a critical distance of the alveolar bone.

It has been shown that when LPS is added to osteoclast precursor cultures containing osteoblasts and/or stromal cells, it can directly stimulate bone resorption.[8,9] Receptor activator of NF-KB ligand and osteoprotegerin are the key regulators of bone remodeling and are directly involved in the differentiation, activation, and survival of osteoclasts and osteoclast precursors.

Destruction of the extracellular matrix

There is significant evidence that collagenases, gelatinases, stromelysins, membrane-type MMPs, and other MMPs play an important role in the periodontal tissue destruction. MMPs are upregulated in the periodontal inflammation. The main function of MMP-8 is the degradation of interstitial collagens.[10]

Recommendation

Chronic periodontitis is an inflammatory disease that can cause a state of insulin resistance and in turn can affect the glycemic status of the individual.

Q9: What is the epidemiological burden and financial burden of periodontal disease globally and in India?

There has been substantial improvement in the oral health of populations globally. Certain communities worldwide, particularly among underprivileged groups in developed and developing countries, still face oral health issues. Periodontal diseases have historically been considered the most important global oral health burden. The recent Global Burden of Disease Study, 1990–2010 indicates the following: (i) the overall prevalence of severe periodontitis is 11.2%, with approximately 743 million people affected, making periodontitis the sixth most prevalent disease worldwide, and (ii) from 1990 to 2010, there was an increase in the global burden of periodontal diseases by 57.3%.[11-14]

Different sections of the population are disproportionally affected by periodontal disease. Evidence has suggested an inverse relationship between periodontal disease and income. Low-income individuals have 1.8 times increased odds of severe periodontal disease as compared to high-income individuals.[15] Different age groups have different prevalence and severity of periodontal diseases, and the severity of the disease increases with advancing age. Although it is known that the prevention of periodontal disease is possible, the treatment of periodontal disease is usually sought when the extent and severity of disease increase because its early stages are usually asymptomatic.[16,17]

Periodontal disease burden

Certain landmark studies were performed to assess the prevalence rate of periodontitis in different geographical regions of India.[18-20] They found an average greater prevalence in older age groups above 40 years of age.

According to the National Oral Health Survey aided by the Dental Council of India, New Delhi, during 2002–2003, a three-stage sampling design was adopted to select 210 rural and 110 urban subjects in each of the age groups, viz., 5, 12, 15, 35–44, and 65–74 years, from each homogeneous region, comprising a number of districts of each state, and on the basis of geographical factors used by the Planning Commission. The community periodontal index was used for disease assessment, and the prevalence reported was 57%, 67.7%, 89.6%, and 79.9% in the age groups of 12, 15, 35–44, and 65–74 years, respectively.[21,22] The overall prevalence of periodontitis increases with age, disproportionately affects vulnerable segments of the population, and is a source of social inequality.

Systemic health and financial burden due to periodontal disease

Substantial evidence also shows that there could be systemic effects of periodontitis, which could be attributed to the hematogenous dissemination of both bacteria and bacterial products originating in the oral biofilms and inflammatory mediators originating in the inflamed periodontium. Through these mechanisms, periodontitis can cause various systemic diseases including diabetes, atherosclerosis, rheumatoid arthritis, and pulmonary infections. Periodontal attachment loss and bone loss due to severe periodontitis result in tooth loss, which, in turn, can lead to loss of masticatory function. Loss of masticatory function affects nutrition as subjects with masticatory dysfunction experience changes in their dietary habits, usually incorporating more starch and fats and less fresh fruit and vegetables in their diet.

Global perspective

Considering the number of treatment options, it is equally important to render cost-effective therapies. The estimated national expenditure for periodontal diseases in the United States of America almost doubled from 1997 to 2006. The estimated national expenditures for periodontal disease exceeded the expenditure for any one of the five most expensive medical conditions.[23] The disease burden needs to be further reduced, and there is also a need for new and more cost-effective prevention and treatment strategies that result in sustained oral health with minimal reliance on patient compliance and regular access to professional dental care.

Indian perspective

The scenario in India is no different. Although no sufficient evidence is available to date, the financial burden with regard to periodontal diseases in India is extensive. India is a developing country, and the awareness and the attitude of the patients toward oral health play an important role in the economy of dental fraternity. Lack of awareness, ignorance of initial symptoms, and the cost involved in the treatment refrain patients from seeking immediate attention to oral disease. Particularly, for patients with periodontitis having systemic complications, such as diabetes, they rather tend to ignore oral health owing to increased expenses. To deal with this situation, cost-effective therapies should be introduced, and dental insurances should be made mandatory for the working class. It would rather be useful in rendering effective oral therapy and controlling systemic implications.

Recommendations

1. The overall global burden of periodontal disease should be considered when treating patients with DM

2. The correspondence between physicians and dentists should be contemplated, as the prevalence rate of periodontal disease is higher among patients with diabetes, as it can influence the progression of periodontal disease severity. Both diseases increase the epidemiological and financial burden
3. Delayed treatment of periodontal disease can cause loss of teeth and increase the financial burden of the patient, as replacement therapy may be costlier
4. Cost-effective and timely supportive periodontal therapy can help in dealing with the national and global financial burden.

Q10: What are the main clinical entities, their signs and symptoms, and diagnostic criteria for periodontal diseases?

Periodontal diseases are a group of diseases that affect the periodontium. Periodontium comprises supporting tissues of the tooth and includes the gingiva, cementum, alveolar bone, and periodontal ligament. Gingiva is defined as the oral mucosa that surrounds the tooth in a collar-like pattern. The gingival sulcus is a shallow sulcus that is approximately 2–3 mm in depth. Another portion of the gingiva is firmly attached to the alveolar bone and provides a firm area for buffering during mastication and brushing. It varies between 1 and 9 mm. In health, the gingiva looks coral pink in color with varying degrees of pigmentation and has a firm and resilient attached gingiva. The alveolar bone follows the cementoenamel junction (CEJ) and, on average, lies 2 mm apical to the CEJ in health.

Absence of BOP, erythema and edema, patient symptoms, and attachment and bone loss define gingival health in the intact periodontium. Normal bone levels range from 1.0 to 3.0 mm apical to the CEJ.[24]

The diagnosis of periodontal diseases requires a mouth mirror, University of North Carolina-15 (UNC-15) periodontal probe, and a sound technique for probing the gingival sulcus.

Periodontal diseases are broadly classified into three categories: gingival diseases and conditions, periodontitis, and other conditions affecting the periodontium.[25]

Gingival disease can be plaque induced or nonplaque induced. The basic difference lies in the etiology. The primary etiology of plaque-induced gingivitis is the local deposits of biofilm, whereas the nondental plaque-induced gingival conditions comprise a group of conditions that are not plaque induced and may be manifestations of a systemic disease or may be localized to the oral cavity (e.g., bacterial, viral, or fungal origin). Plaque removal generally does not resolve these conditions.[24]

Gingivitis is an inflammation of the gingiva and does not involve the periodontal ligament and bone. The classical clinical signs of inflammation that manifest clinically in gingivitis are redness, BOP, swelling (observed as loss of knife-edged gingival margin and blunting of papillae). The patient may report symptoms of bleeding gums, metallic/altered taste, redness of swollen gums, bad breath, difficulty in eating, and pain.[24]

In gingivitis, the inflammation is localized to the gingival tissue, and there is no bone loss or clinical attachment loss (CAL); hence, radiographs will not be of any use to diagnose gingivitis.

Periodontitis is a chronic inflammatory disease associated with plaque biofilms and characterized by progressive destruction of the periodontal tissues. Loss of periodontal tissue results in CAL, alveolar bone loss, presence of periodontal pocketing, and gingival bleeding. Patients may experience recession, furcation involvement, and mobility. An interproximal CAL of ≥2 mm or ≥3 mm at two or more nonadjacent teeth can be used as the diagnostic criteria for periodontitis.[26]

The severity of periodontitis can generally be characterized as mild (CAL = 1–2 mm), moderate (CAL = 3–4 mm), and severe (CAL = >5 mm).

Loss of periodontal tissue results in CAL and alveolar bone loss and is a differentiating factor between gingivitis and periodontitis.

Recommendations

1. The dentist should have an appropriate armamentarium, especially a UNC-15 periodontal probe, for evaluating and diagnosing periodontal conditions
2. Knowledge of the clinical signs and symptoms of periodontal diseases and their differentiating features would be of great help to the dentist. The ISP guidelines for periodontal care would be useful for the practicing dentist for an overview
3. The differentiating feature between gingivitis and periodontitis is the presence of CAL in periodontitis cases.

Q11: What is the role of diabetes in light of new classification for periodontal diseases and has a more distinct role be considered as a risk factor for periodontal diseases and as a prognostic factor?

The new classification of periodontal disease characterizes the most common form of periodontitis, also termed as "periodontitis" (other two types being necrotizing periodontitis and periodontitis as a direct manifestation of systemic diseases), on the basis of staging and grading.[25]

Staging describes the severity of disease at presentation and includes an account of the extent and distribution of the disease and probable complexity of disease management.[26]

Grading is based on an analysis of the rate of periodontitis progression and evaluation of the risk for further progression. Recognized risk factors such as cigarette smoking or diabetes affect the rate of progression of periodontitis, help clinicians estimate the future course of the disease, and consequently, may play an important role in the transition from one stage to the next.[26]

Improved knowledge of risk factors affecting periodontitis has led to these risk factors being given such an importance in the classification itself. Diabetes status is one of the most important recognized factors, which defines the grading of periodontitis at the time of diagnosis along with the rate of bone loss.[26]

Glycemic levels have been included as "grade modifiers" in the classification. HbA1c <7.0% in patients will place the patients in Grade B, and HbA1c ≥7.0% in patients with diabetes puts the patients in Grade C at the time of diagnosis.[26]

A risk factor shifts the grade score to a higher grade, independent of the rate of progression. For example, a case of moderate CAL would be Stage II and a moderate progression rate would be graded as Grade B. The presence of poorly controlled type 2 diabetes in a patient can adversely affect the rate of progression and can shift the patient's disease grade to Grade C. Therefore, diabetes here acts as a risk factor that is able to shift the grade to rapid progression.[26]

Recommendations

1. Knowledge of the patient's glycemic status is important for the dentist to diagnose and determine the future course of disease progression. Management of periodontal patients would require modifications in the treatment plan, depending on the severity of both periodontitis and glycemic status.

Q12: How does untreated and treated periodontal disease affect quality of life?

Patients' health cannot merely be defined as the absence of disease but rather as a composite of physical, mental, emotional, and social well-being of an individual. The WHO has defined a patient's QoL as "perceptions of their position in life in the context of culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns." QoL is a subjective perception and thus highly variable, which tends to change over time under the influence of changing health status, social, and environmental factors.[27]

Patient-oriented evidence that matters provides a more holistic measure of treatment goals than the disease-oriented evidence as it tends to miss out on patients' perspectives. In periodontal therapy, patient-based outcomes such as patient-perceived symptoms, function, satisfaction, and psychological comfort can differ significantly from the results obtained through clinical indicators, but studies measuring these parameters are limited.

Patient-related quality of life measures for untreated periodontitis

1. Functional limitations: decreased chewing capacity, tooth loss
2. Physical pain: associated with acute exacerbations, gingival swelling, temporomandibular dysfunction (as a result of tooth loss, pathologic migration)
3. Psychological discomfort: halitosis, pathologic migration, esthetics, and tooth loss.

The effect of OHRQoL has been explored less frequently for periodontitis than other oral conditions such as dental caries. A significant association in the presence of periodontitis between adults and young individuals with OHRQoL perceived by patients is observed in cross-sectional studies and assessed through systematic reviews.[28-31] The most commonly used instrument to measure OHRQoL in the studies related to periodontitis is the Oral Health Impact Profile 14.[32]

Significant differences were observed between healthy individuals and patients with periodontal disease in terms of OHRQoL measures, i.e., physical, psychological, social, and functional disabilities.[31,33] The severity of periodontal disease had a direct correlation with negative OHRQoL, with pocket depth >5 mm adversely affecting overall QoL.[31,34,35]

Periodontitis has a chronic asymptomatic course and is thus not perceived by patients unless the disease has progressed to an advanced stage. CAL is a gradual process, allowing patient's occlusion and musculature to adapt to the functional demands without the patient being aware of the change. Gingival swelling, sore gums,

gingival recession, missing or drifting teeth, and oral malodor are the most common symptoms given by the patients for adverse OHRQoL.[23]

Undiagnosed and untreated periodontitis has a detrimental effect on masticatory function and is a significant factor associated with tooth loss in the adult population.[36] Tooth loss and tooth mobility lead to detrimental consequences such as temporomandibular disorders, changes in food consumption, and nutritional status.[37,38]

In addition, periodontal disease with coexisting systemic diseases such as cardiovascular disease or diabetes can confound the disease process, thereby exerting a greater impact on patients' QoL.[39]

A consistent association has been seen with periodontal therapy on the improvement of patient-perceived OHRQoL.[39,40] NSPT, irrespective of the type (manual, ultrasonic, quadrant vs. full mouth), has a positive effect on improving the QoL of patients.[39] This perception of the patients was found to be maintained even after 1 year of nonsurgical therapy.[41]

Recommendations

1. Patient-perceived QoL is the true measure of disease status, treatment requirements, and assessment of therapeutic outcomes
2. Periodontitis is an asymptomatic chronic disease. Regular dental checkups will prevent loss of function associated with advanced progression
3. A periodontal treatment plan should include treatment needs diagnosed by the clinician and patient-perceived requirements of esthetics, function, and social/psychological well-being
4. Adequate time should be provided for educating patients regarding the course of periodontitis, treatment goals, and effects of untreated disease burden
5. In the current era of medico-legal complications, after nonsurgical management of periodontitis, patients should be adequately explained regarding the need for surgical intervention and unperceivable changes that are required for long-term stability and maintenance of dentition.

Q13: What signs, symptoms, history, etc., would warrant a complete diagnostic workup for diabetes in an undiagnosed but suspected diabetes patient in a dental clinic?

Majority of the diabetes patients visiting dental clinics have type 2 diabetes (90%–95%)[42,43] and are usually asymptomatic. Since self-monitoring in India is lacking, diabetes is randomly discovered when the blood glucose levels are measured for some other problems, on the advice of a medical practitioner.

The patient's medical history provides important clues related to early signs and symptoms of diabetes. This may be an important diagnostic breakthrough for undiagnosed cases visiting dental clinics.

Classical symptoms of diabetes include:

1. Increased thirst (polydipsia)
2. Frequent micturition with a large amount of urine (polyuria)
3. Increased appetite (polyphagia).

A clinician should be cautious regarding prediabetes and suggest full diagnostic workup for diabetes if the patient profile has a combination of these factors:[44]

1. Predominantly in male patients
2. Age >45 years
3. Family history of diabetes
4. Sedentary lifestyle (physical activity <3 times a week)
5. Obesity with increased waist circumference
6. Increased body mass index (BMI)
7. Female patient: history of gestational diabetes or having delivered a child with >9 pounds (>4.82 kg) weight at the time of birth.

Patient history that should alert a dental practitioner for diagnostic workup:

1. Increased blood pressure (hypertension)
2. Sudden weight loss
3. Malaise
4. Weakness
5. Frequent bed-wetting episodes
6. Dryness of mouth
7. Drowsiness.

Symptoms related to diabetes-associated complications:

1. Blurry vision (retinopathy)

2. Numbness of the feet and hands (neuropathy)
3. Frequent cramps (neuropathy)
4. Irritability (neuropathy)
5. Swollen feet and puffiness under eyes (nephropathy)
6. Fatigue (cardiovascular disease)
7. Slow healing ulcers (delayed wound healing)
8. Frequent infections of gingival tissue/skin/vaginal infections (hyperglycemia).

Oral symptoms of diabetes are given below:
1. Dry mouth
2. Burning mouth
3. Dysgeusia (taste alteration)
4. Sticky mouth with bad breath.

Oral signs of diabetes are given below:
1. Severe periodontal destruction as seen through increased periodontal pocket depths, bone loss, and progressive attachment loss
2. Multiple acute periodontal abscesses
3. Suppuration from pockets
4. Increased sites with BOP after thorough Phase 1 therapy (>30%)
5. *Candida*-related oral lesions: angular cheilitis, median rhomboid glossitis, erythematous (denture-related) stomatitis
6. Tongue abnormalities: fissured tongue, bald tongue, geographic tongue (benign migratory glossitis)
7. Halitosis; typical fishy smell (ketone breath)
8. Dry socket
9. Oral lichen planus (OLP, more common in type 1 diabetes): pain/discomfort, burning sensation, and sensitivity to acidic foods.

The overall prevalence of diabetes is approximately 8% of the world's population. These data do not account for the increasing prevalence of diabetic sleeper cells in the population who have not been diagnosed.[45] It is estimated that 3%–4% of adult patients visiting dental clinics are unaware of their diabetic status. The prevalence of diabetes in the population is more for type 2 diabetes (90%–95%) than for type 1 diabetes (~5%); thus, the available evidence also focuses on type 2 diabetes.[42,43]

There is no evidence of acute effects of diabetes on oral complications. Most signs and symptoms, including oral complications, are representations of long-term effects and thus represent chronic manifestations. Strong evidence exists for the association between elevated BMI and waist circumference in DM. Elevated BMI-related obesity was found to be strongly associated with type 2 diabetes in females (pooled relative risk [RR]: 12.41; confidence interval [CI]: 9.03–17.06).[46]

There is evidence supporting a significant association through cross-sectional and few longitudinal studies between the presence of chronic hyperglycemia and severe periodontitis.[47] Both the prevalence and the incidence of periodontitis are increased in patients with type 2 and type 1 diabetes.[48,49] Diabetes has been shown to increase the risk of the incidence of periodontitis and its progression by 86% (RR: 1.86 [95% CI: 1.3–2.8]) through a meta-analysis of longitudinal prospective studies.[50]

Prediabetes shows a similar predisposition to increased prevalence, incidence, and severity of periodontitis. Support for the association of prediabetes to increased risk of periodontal health was reviewed through two longitudinal and mostly cross-sectional studies. Evidence is limited to certain subpopulations. Its generalization to other populations needs validation through properly conducted longitudinal studies with standardized case definitions for both prediabetes and periodontitis.[51]

There is clinical evidence regarding the association between periodontal abscesses and diabetes.[52] Clinical experience suggests that a single periodontal abscess may be associated with local factors, but multiple abscesses are manifestations of either diabetes or any other medically compromised state. A study on the Saudi Arabian population found that the prevalence of periodontal abscesses in patients with diabetes was 58.6%, and these patients showed HbA1c levels of ≥6.5%.[53]

There is emerging evidence for the presence of halitosis as an alerting signal toward diabetes. A typical fruity ketonic smell is associated with diabetes. Hyperglycemia causes increased oxidative stress, which leads to increased levels of fatty acids and methyl nitrate in the bloodstream, resulting in typical ketonic malodor.[54] Halitosis is also due to the release of volatile sulfur compounds by bacteria associated with tongue coating, periodontitis, and hyposalivation. The correlation between ketonic breath and blood glucose levels has the potential for a noninvasive diagnostic value.

Evidence suggests that patients with both type 1 and type 2 diabetes have taste alterations. In a case–control study, ageusia (loss of taste) was found in type 1 (3%) and type 2 (5%) diabetes and hypogeusia (reduced taste) in >33% of diabetes.[55] This alteration in taste is seen to be independent of neuropathic complications.[56]

Epidemiological studies indicate an increased prevalence of xerostomia and hyposalivation in patients with diabetes. Patients with diabetes often complain of polydipsia and dry and sticky mouth. However, evidence is indicative and not substantial enough to prove a direct correlation.[57]

Evidence related to the association between DM and *Candida*-related oral mucosal lesions is also limited, although epidemiologically increased prevalence is seen. Assessment of the association is not conclusive due to variations in lesion complexity, study populations, interactions with other risk factors, and lack of longitudinal studies. A probable reason for the concomitant occurrence may be related to the impaired immune response in diabetes, leading to opportunistic infection of *Candida* species. Evidence regarding non-*Candida*-related species is too limited to establish any association with diabetes.[47]

Common autoimmune disorder links OLP with type 1 diabetes. The triad of OLP, hypertension, and diabetes is known as Grinspan syndrome.[58] Evidence related to the association of burning mouth syndrome (BMS) with diabetes is limited due to an overlap between BMS and other diabetes-associated conditions such as xerostomia, taste alterations, *Candida* infections, and neuropathy.[59] OLP may be a manifestation of any of these conditions although studies have reported its increased prevalence in patients with diabetes.[60,61]

There is a lack of clear correlation between the presence of dental caries and diabetes. The same etiological lifestyle factors such as increased carbohydrate intake may be a causal factor for both diseases.[47]

Recommendations

1. Diabetes is a chronic disease, and early diagnosis and proper referral have the potential to prevent adverse complications
2. Presence of oral signs of destructive periodontal disease with severity inconsistent in relation to local factors, suppuration, presence of multiple periodontal abscesses, tongue abnormalities, *Candida*-related lesions, halitosis, and persistent BOP after Phase 1 therapy are red flags for suspecting the presence of underlying systemic factors (diabetes)
3. Patient-reported symptoms of taste alteration, sticky and dry mouth, bad breath, and burning sensation in the oral mucosa should be correlated with oral signs and patient's medical history to obtain a holistic view of the patient's systemic condition
4. Screening prediabetes risk test is a useful tool that can be used for suspected diabetes patients visiting dental clinics
5. An inclusive, patient-oriented multidisciplinary treatment approach is the need of the hour, and a robust referral system should be developed between dental and medical teams.

Q14: Are there any compromised treatment goals for periodontal treatment in medically compromised patients. In other words, due to the underlying medical condition (other than diabetes), which may interfere with an idealistic treatment goal, is there an evidence for an acceptable compromised periodontal treatment goals?

Therapeutic end points are objective measurements of outcomes of periodontal therapy. Probing pocket depth reduction and gain in clinical attachment levels provide undisputed evidence toward successful therapy but are still considered as surrogate end points. True end points are measured in terms of retention of tooth in the oral cavity through longitudinal follow-up and the patient's QoL.[62]

The oral health goal set by the WHO is that the world population should retain at least 20 teeth throughout life.[63] Periodontal therapeutic goals are the attainment of clinical gingival health after treatment of active disease. Periodontal classification defines acceptable clinical gingival health following successful periodontal therapy in terms of the absence of gingival redness (erythema), swelling (edema), and BOP (<10%) in reduced periodontium with probing pocket depth ≤3 mm.[24] The term "clinically healthy" should be used only for the absence of clinical inflammation on either intact periodontium or reduced periodontium. Definition or paradigm detailing a compromised state needs to be defined.[64,65] Periodontal disease in medically compromised patients has a synergistic inflammatory response, creating additional treatment requirements. In patients with systemic diseases, the ideal treatment end points are thus compromised. The goal of treatment focuses on maintenance of the remaining teeth in the oral cavity without active periodontal disease.

Currently, no scientific evidence is available for compromised end point therapy. Restoration of diseased attachment or bone levels in periodontitis patients with systemic complications to the predisease level through any treatment modality is not possible. Therapeutic goals, therefore, shift toward the control of local and systemic disease risk factors, to minimize inflammation and to stabilize probing depths and clinical attachment levels.

Evidence suggests two treatment outcomes:[65]
1. Maintenance of periodontal stability
2. Periodontal disease control/remission.

Periodontal stability is a state in which local and systemic factors related to periodontitis are controlled, resulting in minimal BOP (<10%), control of progressive periodontal destruction, and with pocket depth maintained at ≤4 mm.[64,65] This state is an acceptable compromise as it results in minimal inflammation and control of modifiable risk factors, resulting in optimal treatment response.

In patients where control of predisposing or modifying factors is not possible, the therapeutic aim should be disease control/remission. Periodontal treatment results in reduction (not total resolution) of inflammation and shows slight improvement in probing depth reduction and attachment level gains. Stringent, more aggressive, and compliant supportive periodontal therapy is required for the maintenance of these cases. Dental practitioners should aim for this therapeutic goal in medically compromised patients with uncontrolled modifiable factors (diabetes, cardiovascular diseases, etc.). A residual pocket depth of ≥6 mm and BOP (≥30%) even after active periodontal therapy result in an increased risk of tooth loss.[66]

Recommendation
1. Periodontal therapy should aim to achieve clinical gingival health through active treatment and frequent periodontal maintenance
2. The true therapeutic end point for successful therapy is maintenance of at least 20 teeth in the oral cavity (WHO Health Goal) without active periodontal disease
3. Achievement of periodontal stability is an acceptable treatment outcome that would require a synergistic partnership of a dental practitioner in consultation with a medical counterpart on a compliant patient
4. In medically compromised states, active therapy and frequent periodontal maintenance should be able to achieve disease control/remission stage. It is to be remembered that this stage is very unstable and would require more aggressive and subjectively tailored recall programs
5. Systemic complications require a hand-in-hand approach between dentists and physicians as treatment goals and outcomes are inter-related. A robust referral system and inclusive treatment planning would allow for the achievement of periodontal stability with well-controlled systemic end points
6. The balance between medical and perceived periodontal treatment needs should be reached based on a comprehensive QoL assessment.

REFERENCES

1. Cekici A, Kantarci A, Hasturk H, Van Dyke TE. Inflammatory and immune pathways in the pathogenesis of periodontal disease. Periodontol 2000 2014;64:57-80.
2. Gemmell E, Marshall RI, Seymour GJ. Cytokines and prostaglandins in immune homeostasis and tissue destruction in periodontal disease. Periodontol 2000 1997;14:112-43.
3. Seymour GJ. Importance of the host response in the periodontium. J Clin Periodontol 1991;18:421-6.
4. Seymour GJ, Gemmell E. Cytokines in periodontal disease: Where to from here? Acta Odontol Scand 2001;59:167-73.
5. Novak JM, Novak KF. Chronic periodontitis. In: Carranza FA, editor. Clinical Periodontology. Philadelphia: Saunders Elsevier; 2006. p. 494-9.
6. Page RC, Schroeder HE. Pathogenesis of inflammatory periodontal disease. A summary of current work. Lab Invest 1976;34:235-49.
7. Zadeh HH, Nichols FC, Miyasaki KT. The role of the cell-mediated immune response to *Actinobacillus actinomycetemcomitans* and *Porphyromonas gingivalis* in periodontitis. Periodontol 2000 1999;20:239-88.
8. Henderson B, Nair SP, Ward JM, Wilson M. Molecular pathogenicity of the oral opportunistic pathogen *Actinobacillus actinomycetemcomitans*. Annu Rev Microbiol 2003;57:29-55.
9. Graves DT, Cochran D. The contribution of interleukin-1 and tumor necrosis factor to periodontal tissue destruction. J Periodontol 2003;74:391-401.
10. Sorsa T, Tjäderhane L, Konttinen YT, Lauhio A, Salo T, Lee HM, *et al*. Matrix metalloproteinases: Contribution to pathogenesis, diagnosis and treatment of periodontal inflammation. Ann Med 2006;38:306-21.
11. Tonetti MS, Jepsen S, Jin L, Otomo-Corgel J. Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. J Clin Periodontol 2017;44:456-62.
12. Jin LJ, Lamster IB, Greenspan JS, Pitts NB, Scully C, Warnakulasuriya S. Global burden of oral diseases: Emerging concepts, management and interplay with systemic health. Oral Dis 2016;22:609-19.
13. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJ, Marcenes W. Global burden of severe periodontitis in 1990-2010: A systematic review and meta-regression. J Dent Res 2014;93:1045-53.
14. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, *et al*. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2197-223.
15. Borrell LN, Crawford ND. Socioeconomic position indicators and periodontitis: Examining the evidence. Periodontol 2000 2012;58:69-83.

16. Tadjoedin FM, Fitri AH, Kuswandani SO, Sulijaya B, Soeroso Y. The correlation between age and periodontal diseases. J Int Dent Med Res 2017;10:327-32.
17. Jin L. Group E. Initiator paper. Interprofessional education and multidisciplinary teamwork for prevention and effective management of periodontal disease. J Int Acad Periodontol 2015;17:74-9.
18. Day CD, Shourie KL. A roentgenographic survey of periodontal disease in India. J Am Dent Assoc 1949;39:572-88.
19. Mehta F, Baretto MA, Raut RB, Sanjana MK, Shourie KL. The incidence of periodontal disease amongst Indian adults. J All India Assoc 1953;2:4.
20. Ramfjord SP, Emslie RD, Greene JC, Held AJ, Waerhaug J. Epidemiological studies of periodontal diseases. Am J Public Health Nations Health 1968;58:1713-22.
21. Shewale AH, Gattani DR, Bhatia N, Mahajan R, Saravanan SP. Prevalence of periodontal disease in the general population of India-A systematic review. J Clin Diagn Res 2016;10:ZE04-9.
22. Jepsen S, Berglundh T, Genco R, Aass AM, Demirel K, Derks J, *et al*. Primary prevention of peri-implantitis: Managing peri-implant mucositis. J Clin Periodontol 2015;42 Suppl 16:S152-7.
23. Beikler T, Flemmig TF. Oral biofilm-associated diseases: Trends and implications for quality of life, systemic health and expenditures. Periodontol 2000 2011;55:87-103.
24. Chapple IL, Mealey BL, Van Dyke TE, Bartold PM, Dommisch H, Eickholz P, *et al*. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of Workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Periodontol 2018;89 Suppl 1:S74-S84.
25. Caton JG, Armitage G, Berglundh T, Chapple IL, Jepsen S, Kornman KS, *et al*. A new classification scheme for periodontal and peri-implant diseases and conditions-Introduction and key changes from the 1999 classification. J Clin Periodontol 2018;45 Suppl 20:S1-S8.
26. Papapanou PN, Sanz M, Buduneli N, Dietrich T, Feres M, Fine DH, *et al*. Periodontitis: Consensus report of Workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Periodontol 2018;89 Suppl 1:S173-82.
27. Locker D, Allen F. What do measures of 'oral health-related quality of life' measure? Community Dent Oral Epidemiol 2007;35:401-11.
28. Ferreira MC, Dias-Pereira AC, Branco-de-Almeida LS, Martins CC, Paiva SM. Impact of periodontal disease on quality of life: A systematic review. J Periodontal Res 2017;52:651-65.
29. Fotedar S, Sharma KR, Fotedar V, Bhardwaj V, Chauhan A, Manchanda K. Relationship between oral health status and oral health related quality of life in adults attending H.P Government Dental College, Shimla, Himachal Pradesh--India. Oral Health Dent Manag 2014;13:661-5.
30. Llanos AH, Silva CG, Ichimura KT, Rebeis ES, Giudicissi M, Romano MM, *et al*. Impact of aggressive periodontitis and chronic periodontitis on oral health-related quality of life. Braz Oral Res 2018;32:e006.
31. Needleman I, McGrath C, Floyd P, Biddle A. Impact of oral health on the life quality of periodontal patients. J Clin Periodontol 2004;31:454-7.
32. Slade GD. Derivation and validation of a short-form oral health impact profile. Community Dent Oral Epidemiol 1997;25:284-90.
33. Jansson H, Wahlin Å, Johansson V, Åkerman S, Lundegren N, Isberg PE, *et al*. Impact of periodontal disease experience on oral health-related quality of life. J Periodontol 2014;85:438-45.
34. Buset SL, Walter C, Friedmann A, Weiger R, Borgnakke WS, Zitzmann NU. Are periodontal diseases really silent? A systematic review of their effect on quality of life. J Clin Periodontol 2016;43:333-44.
35. Meusel DR, Ramacciato JC, Motta RH, Brito Júnior RB, Flório FM. Impact of the severity of chronic periodontal disease on quality of life. J Oral Sci 2015;57:87-94.
36. Ramseier CA, Anerud A, Dulac M, Lulic M, Cullinan MP, Seymour GJ, *et al*. Natural history of periodontitis: Disease progression and tooth loss over 40 years. J Clin Periodontol 2017;44:1182-91.
37. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: A systematic review and meta-analysis. Health Qual Life Outcomes 2010;8:126.
38. Graziani F, Music L, Bozic D, Tsakos G. Is periodontitis and its treatment capable of changing the quality of life of a patient? Br Dent J 2019;227:621-5.
39. Shanbhag S, Dahiya M, Croucher R. The impact of periodontal therapy on oral health-related quality of life in adults: A systematic review. J Clin Periodontol 2012;39:725-35.
40. Goel K, Baral D. A comparison of impact of chronic periodontal diseases and nonsurgical periodontal therapy on oral health-related quality of life. Int J Dent 2017;2017:9352562.
41. Wong RM, Ng SK, Corbet EF, Keung Leung W. Non-surgical periodontal therapy improves oral health-related quality of life. J Clin Periodontol 2012;39:53-61.
42. Centers for Disease Control and Prevention. Type 2 Diabetes. Centers for Disease Control and Prevention; 2019. Available from: https://www.cdc.gov/diabetes/basics/type 2.html. [Last accessed on 2020 Aug 22].
43. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in diabetes since 1980: A pooled analysis of 751 population-based studies with 4.4 million participants. Lancet 2016;387:1513-30.
44. Centers for Disease Control and Prevention. Prediabetes-Your Chance to Prevent Type 2 Diabetes. Centers for Disease Control and Prevention; 2020. Available from: http://bit.ly/2hMpYrt. [Last accessed on 2020 Aug 24].
45. Zhang N, Yang X, Zhu X, Zhao B, Huang T, Ji Q. Type 2 diabetes mellitus unawareness, prevalence, trends and risk factors: National Health and Nutrition Examination Survey (NHANES) 1999-2010. J Int Med Res 2017;45:594-609.
46. Guh DP, Zhang W, Bansback N, Amarsi Z, Birmingham CL, Anis AH. The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis. BMC Public Health 2009;9:88.
47. Verhulst MJ, Loos BG, Gerdes VE, Teeuw WJ. Evaluating all potential oral complications of diabetes mellitus. Front Endocrinol (Lausanne) 2019;10:56.

48. Mealey BL, Oates TW; American Academy of Periodontology. Diabetes mellitus and periodontal diseases. J Periodontol 2006;77:1289-303.
49. Meenawat A, Punn K, Srivastava V, Meenawat AS, Dolas RS, Govila V. Periodontal disease and type I diabetes mellitus: Associations with glycemic control and complications. J Indian Soc Periodontol 2013;17:597-600.
50. Nascimento GG, Leite FR, Vestergaard P, Scheutz F, López R. Does diabetes increase the risk of periodontitis? A systematic review and meta-regression analysis of longitudinal prospective studies. Acta Diabetol 2018;55:653-67.
51. Kocher T, König J, Borgnakke WS, Pink C, Meisel P. Periodontal complications of hyperglycemia/diabetes mellitus: Epidemiologic complexity and clinical challenge. Periodontol 2000 2018;78:59-97.
52. Laudenbach JM, Simon Z. Common dental and periodontal diseases: Evaluation and management. Med Clin North Am 2014;98:1239-60.
53. Alagl AS. Periodontal abscess as a possible oral clinical sign in the diagnosis of undiagnosed diabetes mellitus of elderly in a dental clinic set up-A 7-year cross-sectional study. J Investig Clin Dent 2017;8:1-6.
54. Riddell MC, Gallen IW, Smart CE, Taplin CE, Adolfsson P, Lumb AN, *et al*. Exercise management in type 1 diabetes: A consensus statement. Lancet Diabetes Endocrinol 2017;5:377-90.
55. De Carli L, Gambino R, Lubrano C, Rosato R, Bongiovanni D, Lanfranco F, *et al*. Impaired taste sensation in type 2 diabetic patients without chronic complications: A case-control study. J Endocrinol Invest 2018;41:765-72.
56. Neiers F, Canivenc-Lavier MC, Briand L. What does diabetes "taste" like? Curr Diab Rep 2016;16:49.
57. López-Pintor RM, Casañas E, González-Serrano J, Serrano J, Ramírez L, de Arriba L, *et al*. Xerostomia, hyposalivation, and salivary flow in diabetes patients. J Diabetes Res 2016;2016:4372852.
58. Gupta S, Jawanda MK. Oral lichen planus: An update on etiology, pathogenesis, clinical presentation, diagnosis and management. Indian J Dermatol 2015;60:222-9.
59. Scala A, Checchi L, Montevecchi M, Marini I, Giamberardino MA. Update on burning mouth syndrome: Overview and patient management. Crit Rev Oral Biol Med 2003;14:275-91.
60. Collin HL, Niskanen L, Uusitupa M, Töyry J, Collin P, Koivisto AM, *et al*. Oral symptoms and signs in elderly patients with type 2 diabetes mellitus. A focus on diabetic neuropathy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;90:299-305.
61. Eltas A, Tozoğlu U, Keleş M, Canakci V. Assessment of oral health in peritoneal dialysis patients with and without diabetes mellitus. Perit Dial Int 2012;32:81-5.
62. Loos BG, Needleman I. Endpoints of active periodontal therapy. J Clin Periodontol 2020;47 Suppl 22:61-71.
63. Hobdell M, Petersen PE, Clarkson J, Johnson N. Global goals for oral health 2020. Int Dent J 2003;53:285-8.
64. Trombelli L, Farina R, Silva CO, Tatakis DN. Plaque-induced gingivitis: Case definition and diagnostic considerations. J Clin Periodontol 2018;45 Suppl 20:S44-S67.
65. Lang NP, Bartold PM. Periodontal health. J Periodontol 2018;89 Suppl 1:S9-S16.
66. Matuliene G, Pjetursson BE, Salvi GE, Schmidlin K, Brägger U, Zwahlen M, *et al*. Influence of residual pockets on progression of periodontitis and tooth loss: Results after 11 years of maintenance. J Clin Periodontol 2008;35:685-95.

SECTION C - BIDIRECTIONAL RELATIONSHIP BETWEEN DIABETES AND PERIODONTAL DISEASES

This section is divided into two parts. Section C1 deals with the effect of diabetes on periodontal status, and Section C2 deals with the effect of periodontal status on diabetes.

SECTION C1: EFFECT OF DIABETES ON PERIODONTAL HEALTH

Q15: Is diabetes (prediabetes, diabetes, and poorly controlled diabetes) a strong risk predictor for periodontal disease?

Studies conducted by Abduljabbar *et al*.[1] and Andriankaja and Joshipura[2] have exhibited higher periodontal parameters and a strong association with BOP in the prediabetes group than in the control group, respectively. However, a handful of research investigated between prediabetes and healthy subjects did not observe any significant differences.[3] Kowall *et al*.[4] stated that bacterial dysbiosis can also contribute to prediabetes development in susceptible individuals due to shared microbial load. The limited panel of four inflammatory mediators (adiponectin, TNFα, IL-6, and high-sensitivity CRP) evaluated in a cross-sectional study could not completely reveal the temporality of the interrelationship among microbial exposure, systemic infiltration, and development of prediabetes.[4] The association between well-controlled diabetes and periodontal disease has been studied by Kowall *et al*.[4] and Zadik *et al*.[5] Although an association between alveolar bone loss and well-controlled diabetes was established, there was no adjustment for potential confounding factors. Crosstalk with direct and indirect changes in both diseases reflects the biological process and also explains the true pathway of causal comorbidity.[1] There is strong evidence for the inflammation as one of the important linking mechanisms to justify along with various important parameters in the literature to substantiate that poorly controlled diabetes is a strong risk factor for periodontal disease.[6,7] Demmer *et al*.[8] and Islam *et al*.[9] stated that periodontal disease was significantly worsened with an increased risk of tooth loss in patients with poorly controlled diabetes, with an odds ratio of 1:3, after adjusting for potential confounding factors. The limited evidence states that consistent maintenance of the glycemic level does not make it a high-risk predictor for periodontal disease. Moreover, large prospective longitudinal studies would provide a tool to decide whether prediabetes and well-controlled diabetes can be used as a predictor for the early prevention or control of chronic

inflammatory development of periodontal disease among high-risk populations. However, satisfactory evidence is available in the literature to conclude that poorly controlled diabetes is a strong predictor of periodontal disease.[6-9]

Recommendations

1. Poorly controlled diabetes is a well-documented and strong predictor for periodontal disease
2. Maintenance of good glycemic control does not make diabetes a high-risk predictor for periodontal disease
3. The role of prediabetes as a predictor of periodontal disease needs to be explored by well-designed prospective studies.

Q16: Does diabetes affect the periodontal microbiota and whether the control of glycemic status impacts the periodontal microbiota?

Does diabetes affect the periodontal microbiota?

Contemporary evidence has shown that the increased glycemic levels in diabetes people have an effect on the periodontal microflora.[10] There is an ecological shift in the microbiota from healthy individuals to those with periodontal disease. A similar paradigm shift from Gram-positive facultative anaerobes to predominantly anaerobic pathologic species has been observed in diabetes people as compared to nondiabetes people.[11] Varied microbiota is observed in patients with DM as compared to healthy individuals.[12] 16rRNA gene cloning and sequencing also demonstrated significant differences in the subgingival microorganisms among subjects with and without diabetes.[13] Quantitative and qualitative changes in pathogenic periodontal microflora have been observed by various researchers, leading to an oral diabetic dysbiotic state with an increased number of organisms such as *Porphyromonas*.[14-18]

Some researchers have observed biochemical changes in elevated antibody titers toward periodontal pathogens in hyperglycemic subjects independent of other risk factors.[19] A strong association was also noted between fasting glucose levels and orange-red cluster periodontal microorganisms (*Prevotella melaninogenica*, *Prevotella intermedia*, *Prevotella nigrescens*, and *Porphyromonas gingivalis mixture*).[1] Hence, strong evidence based on the published literature showed elevated levels of *P. gingivalis* in DM subjects in comparison to healthy individuals.[2] There is minimal-to-moderate evidence regarding elevated levels of other periodontal pathogens in patients with diabetes as compared to healthy controls.[2]

Recommendations

1. Oral microflora significantly varies between DM and healthy subjects, and microbial biodiversity is observed in periodontitis patients with and without uncontrolled diabetes
2. Increased glucose levels in the gingival crevicular fluid (GCF) in patients with DM enhance the growth of certain pathogens by contributing as an additional nutritional source
3. In periodontal infection, the pathogen *P. gingivalis* is in elevated proportions, which majorly contributes to microbial dysbiosis and enhances insulin resistance.

Whether the control of glycemic status affects the periodontal microbiota?

A review stated that very few clinical studies have assessed glycemic status and its association with oral microbiota.[1] The microbial profile in diabetes patients with a poorly controlled glycemic index and chronic periodontitis demonstrated significant variations in different periodontal pathogens.[13,18] Orange and red cluster microorganisms such as *P. melaninogenica*, *P. intermedia*, *P. nigrescens*, and *P. gingivalis* in moderate-to-severe periodontitis patients were noted to be significantly associated with glycemic status.[19] It was also suggested that poor glycemic status promoted the growth of fermenting organisms that were active in the production of propionate and succinate.[20] Hence, subjects with uncontrolled DM are more prone to a shift toward microbial dysbiosis due to impaired immunity and metabolism.[16]

Recommendations

1. A limited number of randomized clinical trials have investigated improvements in periodontal microbiomes and their interaction with glycemic regulation
2. The limited data state that an elevated level of periodontal pathogens is noted in subjects with poor glycemic status, and there exists an oral microbial biodiversity in subjects with and without controlled diabetes
3. The glycemic status in DM subjects affects and alters the oral biofilm composition.

Q17: Does diabetes increase systemic cytokine levels (of interest to oral health)?

There is a substantial body of evidence suggesting an increase in inflammatory biomarkers in patients with type 2 DM. These changes in diabetes patients and alterations in immune biomarkers affect various organs, leading to complications such as neuropathy, nephropathy, retinopathy, cardiovascular diseases, and periodontal disease. It was also observed during profiling of type 2 DM patients that CRP and lipid profiles can be considered as the predictors of diabetes development in nondiabetes individuals.[21,22]

It is also proven that the prominent pro-inflammatory biomarkers such as TNF-α, macrophage-inhibiting cytokine, IL-1, and IL-6 are elevated in diabetes and leads to the state of insulin resistance and various other resultant complications.[23-26] It has also been observed that the blockade of IL-1 by receptor antagonists leads to the improvement in glycemia and beta-cell secretory functions. Various pro-inflammatory cytokines such as TNF-α, IL-6, IL-1, and CRP are elevated in periodontal disease and play an important role in periodontal damage.[27,28]

Recommendations

1. Diabetes leads to elevated levels of pro-inflammatory biomarkers and plays an important role in the development of various inflammatory diseases, including periodontal disease
2. Cytokine level and glycemic control are closely related; hence, such patients are at a high risk for destructive periodontal diseases.

Q18: Does diabetes increase the cytokine levels in the gingival crevicular fluid, which could potentially contribute to periodontal destruction and whether control of glycemic status improves the local cytokine profile?

There is limited evidence to suggest elevated levels of cytokines in the GCF in diabetes as compared to the ample evidence, suggesting increased serum cytokine levels in diabetes. The interaction between microorganisms and the host immune–inflammatory response mediates pathological changes in the periodontal tissues, which is possibly affected by hyperglycemia. In the GCF of diabetes patients with or without periodontal disease, increased levels of pro-inflammatory cytokines (including IL-1β, IL-6, and TNF-α) can be a valuable tool for the early detection of periodontal disease. Elevated pro-inflammatory cytokine concentrations in the GCF can also be suggestive of "latent" DM in undiagnosed individuals.[29-32]

Recommendation

1. The consistently increased levels of pro-inflammatory biomarkers in the GCF of diabetes patients with periodontitis as compared to the nondiabetes patients may indicate the role of diabetes in the initiation and progression of periodontal diseases.

Q19: What are the possible mechanistic pathways through which diabetes can influence periodontal health?

1. There is sufficient evidence suggesting inflammation as a link between diabetes and periodontal disease.[1,33-40] Hyperglycemia and insulin resistance are responsible for the enhanced oxidative stress in the periodontal tissues.[1] Altered glucose metabolism has also been associated with changes in the plaque microflora, although evidence for the same is not conclusive.[33] Elevated cytokine levels have been detected in the saliva, gingival biopsies, and GCF. Poorly controlled diabetes lead to elevated levels of IL-1β, TNF-α, IL-4, IL-12, IL-23, IL-6, IL-17, macrophage inflammatory protein α, substance P, CRP, resistin, Macrophage colony-stimulating factor, and MMPs.[1,7,33,34,38] Results from studies involving the use of cytokine antagonists support the theory that cytokine dysregulation plays a significant role in periodontal destruction.[41] There is also enough evidence to suggest that AGE–RAGE interactions, resultant upregulation of the Toll-like receptor 2, 4, and 9 expression along with cytokine dysregulation, lead to an exaggerated inflammatory response, resulting in systemic oxidative stress, and the use of antioxidants/RAGE blockers leads to reduction in both systemic oxidative stress and resultant alveolar bone loss.[1,33-35,39] Defects in PMNs activity and altered monocyte response have also been detected in the blood of diabetes patients.[35] Altered lipid metabolism, endothelial dysfunction with thickening of the basement membrane, and altered collagen metabolism, as evidenced in hyperglycemic conditions, all contribute to increased periodontal destruction and delayed wound healing.[37]

Recommendation

Diabetes and periodontitis are comorbidities with shared underlying pathologic pathways. Hyperglycemia in diabetes affects periodontal health by influencing the oral microbial flora, overexpression of pro-inflammatory cytokines, immunomodulation of fibroblasts, and enhancement of oxidative stress. AGE–RAGE interactions, imbalances in lipid metabolism, and altered collagen, and monocyte response further contribute to the destruction of periodontal tissues.

Q20: Does improvement in glycemic control alone can improve the periodontal health prospectively?

Due to the paucity of randomized controlled trials in this context, there is very limited evidence as to how an improvement in glycemic control alone influences periodontal status.[8,42-47] As diabetes, like any other systemic disease, is a modifying factor and not the primary etiological factor, clinicians should be aware of the individual patient variability (local etiological factors), playing a huge role in the clinical presentation of multifactorial diseases such as periodontitis, wherein a well-controlled diabetes may present with periodontal disease, whereas a poorly controlled diabetes may present with a healthy periodontium. Improvement in glycemic control will have a definite beneficial effect in terms of systemic cytokine profile with the reduction in oxidative stress, but how that

translates into an improvement of periodontal status is yet inconclusive, as there is no clear evidence in the literature corroborating the same.[1,40,46,47]

Recommendations

1. Control of diabetes has a positive influence on the reduction of pro-inflammatory cytokines, microbial dysbiosis, and oxidative stress, which form a part of the mechanistic links between diabetes and periodontal disease
2. Improvement of glycemic control alone may not result in complete resolution of periodontal disease. However, it may prevent further deterioration of periodontal disease, thereby improving the prognosis and response to periodontal therapy
3. Knowledge of the glycemic status of diabetes patients and close collaborative management with the physician is vital for optimal treatment outcomes while treating periodontal disease in diabetes patients.

REFERENCES

1. Abduljabbar T, Al-Sahaly F, Al-Kathami M, Afzal S, Vohra F. Comparison of periodontal and peri-implant inflammatory parameters among patients with prediabetes, type 2 diabetes mellitus and non-diabetic controls. Acta Odontol Scand 2017;75:319-24.
2. Andriankaja OM, Joshipura K. Potential association between prediabetic conditions and gingival and/or periodontal inflammation. J Diabetes Investig 2014;5:108-14.
3. Polak D, Sanui T, Nishimura F, Shapira L. Diabetes as a risk factor for periodontal disease-plausible mechanisms. Periodontol 2000 2020;83:46-58.
4. Kowall B, Holtfreter B, Völzke H, Schipf S, Mundt T, Rathmann W, *et al*. Pre-diabetes and well-controlled diabetes are not associated with periodontal disease: The SHIP Trend Study. J Clin Periodontol 2015;42:422-30.
5. Zadik Y, Bechor R, Galor S, Levin L. Periodontal disease might be associated even with impaired fasting glucose. Br Dent J 2010;208:E20.
6. Oliver RC, Tervonen T. Diabetes-A risk factor for periodontitis in adults? J Periodontol 1994;65 Suppl 5S: 530-8.
7. Grossi SG, Genco RJ. Periodontal disease and diabetes mellitus: A two-way relationship. Ann Periodontol 1998;3:51-61.
8. Demmer RT, Jacobs DR Jr., Singh R, Zuk A, Rosenbaum M, Papapanou PN, *et al*. Periodontal bacteria and prediabetes prevalence in ORIGINS: The Oral Infections, Glucose Intolerance, and Insulin Resistance Study. J Dent Res 2015;94:201S-11S.
9. Islam SK, Seo M, Lee YS, Moon SS. Association of periodontitis with insulin resistance, β-cell function, and impaired fasting glucose before onset of diabetes. Endocr J 2015;62:981-9.
10. Ohlrich EJ, Cullinan MP, Leichter JW. Diabetes, periodontitis, and the subgingival microbiota. J Oral Microbiol 2010;2:10.
11. Ojima M, Takeda M, Yoshioka H, Nomura M, Tanaka N, Kato T, *et al*. Relationship of periodontal bacterium genotypic variations with periodontitis in type 2 diabetic patients. Diabetes Care 2005;28:433-4.
12. Sjödin B, Edblad E, Sondell K, Dahlén G. Minor manifestations of periodontal diseases in young adults with T1DM-periodontal and microbiological findings. Acta Odontol Scand 2012;70:589-96.
13. Casarin RC, Barbagallo A, Meulman T, Santos VR, Sallum EA, Nociti FH, *et al*. Subgingival biodiversity in subjects with uncontrolled type-2 diabetes and chronic periodontitis. J Periodontal Res 2013;48:30-6.
14. Mandell RL, Dirienzo J, Kent R, Joshipura K, Haber J. Microbiology of healthy and diseased periodontal sites in poorly controlled insulin dependent diabetics. J Periodontol 1992;63:274-9.
15. Minty M, Canceil T, Serino M, Burcelin R, Tercé F, Blasco-Baque V. Oral microbiota-induced periodontitis: A new risk factor of metabolic diseases. Rev Endocr Metab Disord 2019;20:449-59.
16. Shi B, Lux R, Klokkevold P, Chang M, Barnard E, Haake S, *et al*. The subgingival microbiome associated with periodontitis in type 2 diabetes mellitus. ISME J 2020;14:519-30.
17. Campus G, Salem A, Uzzau S, Baldoni E, Tonolo G. Diabetes and periodontal disease: A case-control study. J Periodontol 2005;76:418-25.
18. Aemaimanan P, Amimanan P, Taweechaisupapong S. Quantification of key periodontal pathogens in insulin-dependent type 2 diabetic and non-diabetic patients with generalized chronic periodontitis. Anaerobe 2013;22:64-8.
19. Merchant AT, Shrestha D, Chaisson C, Choi YH, Hazlett LJ, Zhang J. Association between serum antibodies to oral microorganisms and hyperglycemia in adults. J Dent Res 2014;93:752-9.
20. Longo PL, Dabdoub S, Kumar P, Artese HP, Dib SA, Romito GA, *et al*. Glycaemic status affects the subgingival microbiome of diabetic patients. J Clin Periodontol 2018;45:932-40.
21. Randeria SN, Thomson GJ, Nell TA, Roberts T, Pretorius E. Inflammatory cytokines in type 2 diabetes mellitus as facilitators of hypercoagulation and abnormal clot formation. Cardiovasc Diabetol 2019;18:72.
22. Esser N, Legrand-Poels S, Piette J, Scheen AJ, Paquot N. Inflammation as a link between obesity, metabolic syndrome and type 2 diabetes. Diabetes Res Clin Pract 2014;105:141-50.
23. Mu ZP, Wang YG, Li CQ, Lv WS, Wang B, Jing ZH, *et al*. Association between tumor necrosis factor-α and diabetic peripheral neuropathy in patients with type 2 diabetes: A meta-analysis. Mol Neurobiol 2017;54:983-96.
24. Lu J, Zhang Y, Dong X, Lu J, Zhang C, Liu J, *et al*. Association between MIC-1 and type 2 diabetes: A combined analysis. Dis Markers 2019;2019:7284691.
25. Gouda W, Mageed L, El Dayem SM, Ashour E, Afify M. Evaluation of pro-inflammatory and anti-inflammatory cytokines in type 1 diabetes mellitus. Bull Natl Res Cent 2018;42:14.
26. Kristiansen OP, Mandrup-Poulsen T. Interleukin-6 and diabetes. Diabetes 2005;54:S114-24.

27. Pan W, Wang Q, Chen Q. The cytokine network involved in the host immune response to periodontitis. Int J Oral Sci 2019;11:30.
28. King GL. The role of inflammatory cytokines in diabetes and its complications. J Periodontol 2008;79:1527-34.
29. Mohamed HG, Idris SB, Ahmed MF, Åstrøm AN, Mustafa K, Ibrahim SO, *et al*. Influence of type 2 diabetes on local production of inflammatory molecules in adults with and without chronic periodontitis: A cross-sectional study. BMC Oral Health 2015;15:86.
30. Engebretson SP, Hey-Hadavi J, Ehrhardt FJ, Hsu D, Celenti RS, Grbic JT, *et al*. Gingival crevicular fluid levels of interleukin-1beta and glycemic control in patients with chronic periodontitis and type 2 diabetes. J Periodontol 2004;75:1203-8.
31. Kardeşler L, Buduneli N, Biyikoğlu B, Cetinkalp S, Kütükçüler N. Gingival crevicular fluid PGE2, IL-1beta, t-PA, PAI-2 levels in type 2 diabetes and relationship with periodontal disease. Clin Biochem 2008;41:863-8.
32. Kurtiş B, Develioğlu H, Taner IL, Baloş K, Tekin IO. IL-6 levels in gingival crevicular fluid (GCF) from patients with non-insulin dependent diabetes mellitus (NIDDM), adult periodontitis and healthy subjects. J Oral Sci 1999;41:163-7.
33. Polak D, Shapira L. An update on the evidence for pathogenic mechanisms that may link periodontitis and diabetes. J Clin Periodontol 2018;45:150-66.
34. Preshaw PM, Alba AL, Herrera D, Jepsen S, Konstantinidis A, Makrilakis K, *et al*. Periodontitis and diabetes: A two-way relationship. Diabetologia 2012;55:21-31.
35. Mealey BL, Oates TW; American Academy of Periodontology. Diabetes mellitus and periodontal diseases. J Periodontol 2006;77:1289-303.
36. Borgnakke WS. IDF Diabetes Atlas: Diabetes and oral health-A two-way relationship of clinical importance. Diabetes Res Clin Pract 2019;157:107839.
37. Ryan ME, Carnu O, Kamer A. The influence of diabetes on the periodontal tissues. J Am Dent Assoc 2003;134 Spec No: 34S-40S.
38. Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F, *et al*. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International Diabetes Federation and the European Federation of Periodontology. Diabetes Res Clin Pract 2018;137:231-41.
39. American Diabetes Association. 4. Comprehensive medical evaluation and assessment of comorbidities: *Standards of Medical Care in Diabetes-2019*. Diabetes Care 2019;42:S34-45.
40. Kocher T, König J, Borgnakke WS, Pink C, Meisel P. Periodontal complications of hyperglycemia/diabetes mellitus: Epidemiologic complexity and clinical challenge. Periodontol 2000 2018;78:59-97.
41. Waykole YP, Doiphode SS, Rakhewar PS, Mhaske M. Anticytokine therapy for periodontal diseases: Where are we now? J Indian Soc Periodontol 2009;13:64-8.
42. Katagiri S, Nitta H, Nagasawa T, Izumi Y, Kanazawa M, Matsuo A, *et al*. Effect of glycemic control on periodontitis in type 2 diabetic patients with periodontal disease. J Diabetes Investig 2013;4:320-5.
43. Oyapero A, Adeniyi A, Sofola O, Ogbera A. Effect of glycemic control on periodontal disease and caries experience in diabetic patients: A pilot study. J Interdiscip Dent 2019;9:99-107.
44. Tanwir F, Tariq A. Effect of glycemic control on periodontal status. J Coll Physicians Surg Pak 2012;22:371-4.
45. Botero JE, Yepes FL, Roldán N, Castrillón CA, Hincapie JP, Ochoa SP, *et al*. Tooth and periodontal clinical attachment loss are associated with hyperglycemia in patients with diabetes. J Periodontol 2012;83:1245-50.
46. Santos VR, Ribeiro FV, Lima JA, Napimoga MH, Bastos MF, Duarte PM. Cytokine levels in sites of chronic periodontitis of poorly controlled and well-controlled type 2 diabetic subjects. J Clin Periodontol 2010;37:1049-58.
47. Ribeiro FV, de Mendonça AC, Santos VR, Bastos MF, Figueiredo LC, Duarte PM. Cytokines and bone-related factors in systemically healthy patients with chronic periodontitis and patients with type 2 diabetes and chronic periodontitis. J Periodontol 2011;82:1187-96.

SECTION C2: EFFECT OF PERIODONTAL DISEASE ON DIABETES

Q21: In a nondiabetes individual, is periodontal disease associated with impaired blood glucose levels and an increased risk for developing diabetes?

There is significant evidence supporting poor glycemic control in nondiabetes patients as presented by an increase in HbA1c, IGT, or metabolic syndrome prevalence, when higher values of periodontal parameters such as pocket probing depth and clinical attachment level are present.[1-8] Evidence based on available systematic reviews and meta-analysis suggests that periodontitis worsens glycemic control over time and may play a role in the increased incidence of type 2 incident diabetes and possibly gestational diabetes.[1,2] There is also evidence for an association between periodontitis and worsening of glycemic control, expressed in terms of HbA1c, FPG, and/or OGTT in people with no diabetes manifestations.[9]

Recommendations

1. Based on the available evidence to date, it seems likely that the presence of chronic periodontitis has the potential to adversely affect glycemic control in nondiabetes individuals. Chronic periodontitis may potentially be a risk factor for the development of type 2 diabetes in nondiabetes individuals
2. Patients with periodontitis are at increased risk of impaired glycemic control, which may lead to an increase in the incidence of incident diabetes

3. Physicians should seek evidence for the presence of oral health problems in high-risk patients, as part of their initial evaluation and ask about signs and symptoms of oral/periodontal diseases (bleeding gums, halitosis, drifting of teeth, tooth mobility, etc.).

Q22: Is there evidence available for the role of periodontal disease in the pathogenesis of diabetes?
There is substantial evidence on the role of periodontal disease in the pathogenesis of diabetes. The common intermediary factors include altered cellular immune response, elevated inflammatory mediators, microangiopathy, AGE, and even proliferation of periodontal pathogens, which play a role in the pathogenesis of diabetes. Periodontitis adversely affects glycemic control and diabetes complications or promotes the development of type 2 diabetes. People with poor periodontal health and type 2 diabetes or normoglycemics have a greater risk of developing poorer glycemic control.[5] Moderate-to-severe periodontitis may increase the risk of type 2 diabetes and lead to poor glycemic control in diabetes.[6] Patients with severe periodontitis might increase the incidence of developing type 2 diabetes.[7]

Recommendations
Periodontal disease and its severity can affect the pathogenesis of diabetes through common interlinking mechanisms such as elevated inflammatory mediators, microangiopathy, and AGEs.

Q23: In diabetes patients, does the severity of periodontal disease affect the glycemic levels; in other words, whether increase in periodontal disease severity worsens the glycemic control?
Periodontal disease is a chronic inflammatory disease caused by dysbiotic microbiota. The inflammatory response is characterized by an increase in the levels of host-derived mediators including IL-6, TNF-α, CRP, and ROS. There is evidence that these mediators are also elevated systemically in individuals with both diabetes and periodontitis, leading to generalized systemic inflammation. Elevated systemic inflammation eventually contributes to insulin resistance, leading to diabetes complications.[3-5] It is evident from clinical studies that the presence of severe periodontitis has been shown to increase the risk of hyperglycemia in people with diabetes.[10] Severe periodontitis is associated with increased HbA1c in individuals with diabetes.[11] Chronic inflammation and infection that result from periodontal disease will adversely affect glycemic control in people with diabetes, which, in turn, could lead to worsening of the periodontal disease.[12] Severe periodontitis also predicts the development of diabetes complications.[13]

Recommendations
1. Severe periodontitis is associated with increased HbA1c levels in individuals with diabetes
2. An increase in the severity of periodontitis increases the risk of hyperglycemia in patients with diabetes
3. The severity of periodontal disease is also associated with an increased incidence of associated complications in diabetes patients.

Q24: Does periodontal disease increase the systemic cytokine levels (of interest to diabetes pathogenesis), and is there a linear relationship between these systemic levels and periodontal disease severity?
Periodontal disease is a chronic inflammatory condition that increases systemic cytokines such as IL-1, IL-6, and TNF-α.[14] Serum CRP levels are also elevated in patients with periodontitis.[15] Elevated levels of inflammatory cytokines IL-1β, IL-6, IL-18, and TNF-α are the main inducers of acute-phase proteins, including CRP, and both have been shown to impair intracellular insulin signaling, potentially contributing to insulin resistance and ensuing hyperglycemia.[16] Chronic inflammatory diseases, i.e., diabetes and periodontitis, are the primary reasons for the increase in circulatory inflammatory mediators. This longstanding hyperglycemic state induced by periodontal inflammation is known to deteriorate the glycemic status and enhance the associated complications of diabetes.[11] The most recent 2017 classification of periodontal disease conditions has envisioned some of the periodontal biomarkers, including inflammatory mediators, as the measures to augment the information provided by the standard clinical parameters to assess the grade and the associated systemic effect of periodontal disease in susceptible individuals.[17]

Recommendations
1. Periodontitis increases the systemic inflammatory mediators, which worsen the glycemic status in a diabetes patient by pooling into a persistent state of systemic inflammation and enhancing insulin resistance
2. Inflammatory mediators associated with periodontal disease, validated by emerging evidence, can be monitored for the assessment of diabetic glycemic control.

Q25: What are the possible mechanistic pathways through which periodontal disease can influence diabetes?
Periodontal infection-mediated upregulation of cytokine synthesis and secretion by chronic stimulus from LPS and products of periodontopathic organisms is documented to enhance the magnitude of the AGE-mediated cytokine response operative in DM.[12] Periodontitis increases oxidative stress, which further affects the glycemic control due to dyslipidemia and β-cell dysfunction in diabetes patients.[18] Periodontitis increases the level of

systemic cytokines and unleashes a series of the pro-inflammatory cascade, and increase in IL-1, IL-6, TNF-α, and cytokine upsurge increases MMP and hydrolase activity and insulin resistance, thus causing hyperglycemia.[11,19] There is strong evidence that the increase in CRP levels in periodontitis leads to worsening of the glycemic status in patients with diabetes.[1] Further, indirect evidence exists for common mechanistic pathways (oxidative stress pathways, dyslipidemia, elevated CRP, and endothelial dysfunction) that may act synergistically in worsening cardiovascular complications in diabetes.[18]

Recommendations

1. Periodontitis constitutes a chronic bacterial challenge affecting the glycemic status by enhancing AGE-mediated inflammatory cytokine response in diabetes patients
2. Elevated levels of circulating pro-inflammatory mediators, especially TNF-α, CRP, and mediators of oxidative stress, in people with diabetes and periodontitis affect the metabolic control of diabetes.

Q26: Is there evidence wherein improving periodontal health improves glycemic levels in prospective studies?

There is consistent evidence that treating/improving periodontal health improves glycemic levels.[20,21] NSPT has been shown to influence glycemic control, as evidenced by the reduction in the HbA1c level up to 0.36%.[22] HbA1c reduction from the meta-analyses ranged from 0.27% to 0.48% at 3–4 months after periodontal therapy, and data on maintenance of the effect for 6 months are insufficient. There is no evidence to support that one periodontal therapy was more effective than another in improving glycemic control in diabetes patients.[7,22,23]

Recommendation

The effect of periodontal therapy in diabetes patients has shown an improvement in glycemic level, as evidenced by the reduction in HbA1c levels in short-term intervals at 3 months' follow-up.

REFERENCES

1. Borgnakke WS, Ylöstalo PV, Taylor GW, Genco RJ. Effect of periodontal disease on diabetes: Systematic review of epidemiologic observational evidence. J Periodontol 2013;84:S135-52.
2. Graziani F, Gennai S, Solini A, Petrini M. A systematic review and meta-analysis of epidemiologic observational evidence on the effect of periodontitis on diabetes An update of the EFP-AAP review. J Clin Periodontol 2018;45:167-87.
3. Nguyen AT, Akhter R, Garde S, Scott C, Twigg SM, Colagiuri S, *et al*. The association of periodontal disease with the complications of diabetes mellitus. A systematic review. Diabetes Res Clin Pract 2020;165:108244.
4. Brownlee M. The pathobiology of diabetic complications: A unifying mechanism. Diabetes 2005;54:1615-25.
5. Borgnakke WS. IDF Diabetes Atlas: Diabetes and oral health-A two-way relationship of clinical importance. Diabetes Res Clin Pract 2019;157:107839.
6. Cao R, Li Q, Wu Q, Yao M, Chen Y, Zhou H. Effect of non-surgical periodontal therapy on glycemic control of type 2 diabetes mellitus: A systematic review and Bayesian network meta-analysis. BMC Oral Health 2019;19:176.
7. Chapple IL, Genco R; Working Group 2 of the Joint EFP/AAP workshop. Diabetes and periodontal diseases: Consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. J Periodontol 2013;84:S106-12.
8. Demmer RT, Desvarieux M, Holtfreter B, Jacobs DR Jr., Wallaschofski H, Nauck M, *et al*. Periodontal status and A1C change: Longitudinal results from the study of health in Pomerania (SHIP). Diabetes Care 2010;33:1037-43.
9. Graziani F, Gennai S, Solini A, Petrini M. A systematic review and meta-analysis of epidemiologic observational evidence on the effect of periodontitis on diabetes: An update of the EFP-AAP review. J Clin Periodontol 2018;45:167-87.
10. Taylor GW, Burt BA, Becker MP, Genco RJ, Shlossman M, Knowler WC, *et al*. Severe periodontitis and risk for poor glycemic control in patients with non-insulin-dependent diabetes mellitus. J Periodontol 1996;67:1085-93.
11. Preshaw PM, Alba AL, Herrera D, Jepsen S, Konstantinidis A, Makrilakis K, *et al*. Periodontitis and diabetes: A two-way relationship. Diabetologia 2012;55:21-31.
12. Grossi SG, Genco RJ. Periodontal disease and diabetes mellitus: A two-way relationship. Ann Periodontol 1998;3:51-61.
13. Shultis WA, Weil EJ, Looker HC, Curtis JM, Shlossman M, Genco RJ, *et al*. Effect of periodontitis on overt nephropathy and end-stage renal disease in type 2 diabetes. Diabetes Care 2007;30:306-11.
14. Preshaw PM, Taylor JJ. How has research into cytokine interactions and their role in driving immune responses impacted our understanding of periodontitis? J Clin Periodontol 2011;38 Suppl 11:60-84.
15. Paraskevas S, Huizinga JD, Loos BG. A systematic review and meta-analyses on C-reactive protein in relation to periodontitis. J Clin Periodontol 2008;35:277-90.
16. Liu C, Feng X, Li Q, Wang Y, Li Q, Hua M. Adiponectin, TNF-α and inflammatory cytokines and risk of type 2 diabetes: A systematic review and meta-analysis. Cytokine 2016;86:100-9.
17. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. J Clin Periodontol 2018;45 Suppl 20:S149-S161.
18. Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F, *et al*. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International Diabetes Federation and the European Federation of Periodontology. Diabetes Res Clin Pract 2018;137:231-41.
19. Polak D, Shapira L. An update on the evidence for pathogenic mechanisms that may link periodontitis and diabetes. J Clin Periodontol 2018;45:150-66.

20. Jain A, Gupta J, Bansal D, Sood S, Gupta S, Jain A. Effect of scaling and root planing as monotherapy on glycemic control in patients of Type 2 diabetes with chronic periodontitis: A systematic review and meta-analysis. J Indian Soc Periodontol 2019;23:303-10.
21. Baeza M, Morales A, Cisterna C, Cavalla F, Jara G, Isamitt Y, *et al*. Effect of periodontal treatment in patients with periodontitis and diabetes: Systematic review and meta-analysis. J Appl Oral Sci 2020;28:e20190248.
22. Simpson TC, Needleman I, Wild SH, Moles DR, Mills EJ. Treatment of periodontal disease for glycaemic control in people with diabetes. Cochrane Database Syst Rev 2010;5:CD004714.
23. Engebretson S, Kocher T. Evidence that periodontal treatment improves diabetes outcomes: A systematic review and meta-analysis. J Periodontol 2013;84:S153-69.

SECTION D - TREATMENT OF PERIODONTAL DISEASE IN DIABETES PATIENTS

Q27: Would the type of diabetes and/or the glycemic levels guide the periodontal treatment options to be instituted?

Effect of type of diabetes on the selection of periodontal treatment options

There is no or minimal evidence of the effect of type of diabetes *per se* on the periodontal treatment options for the patient, as the treatment chosen shall be guided by the type and severity of periodontal disease. However, specific case-to-case tailored periodontal management considerations, such as timing and duration of appointment, alteration in the current medication, intraoperative blood glucose evaluation, and use of antibiotics, should be considered during periodontal treatment planning depending on the diabetic history of the patient, including the type of diabetes.[1-4] Type 1 diabetes people, in particular, may experience episodes of hypoglycemia, owing to greater vulnerability of glycemic fluctuations and peak drug dose.[1,4] Thus, these patients need a more meticulous treatment planning and preparedness of the dental office for the execution of the indicated periodontal treatment procedure.

Effect of glycemic status on the selection of periodontal treatment options

There is strong evidence based on the huge body of published literature that glycemic levels, irrespective of the type of diabetes, remain the most significant determinant of the treatment planned for periodontal disease patients.[1-6] The well-controlled diabetes probably requires no special consideration regarding periodontal therapy as compared to a nondiabetes individual.[1-6] NSPT should be instituted in all diabetes patients at the time of visit.[6] Elective periodontal surgical treatment, if indicated, shall only be performed for patients with HbA1c levels ranging from 6 to 8, at the time of initial or subsequent visits.[1-8] Poorly controlled (HbA1c values >8) diabetes patients with periodontal disease shall be put on maintenance therapy, that is, supportive periodontal treatment (SPT) and planned for periodontal surgical procedures, only after the glycemic levels decrease to the range of 6–8 HbA1c.[3,4] Patients shall be referred to the general physician for control and evaluation of glycemic status.[1-6,8] No periodontal intervention (surgical) should be instituted for diabetes patients reporting to the dental clinic, with HbA1c levels >10, except emergency treatment and that too in consultation with the general physician of the patient.[7,8]

Recommendations

The type of diabetes *per se* does not affect the periodontal treatment options to be selected for diabetes patients with periodontal disease. Glycemic levels (metabolic control of the patient as indicated by HbA1c), however, have an effect on the clinical decisions for the type and timing of the institution of periodontal treatment procedures.

1. There is practically no absolute contraindication to the institution of NSPT in all diabetes patients with due consideration of their systemic status
2. Surgical periodontal therapy should be reserved for use in diabetes patients with periodontal disease and glycemic levels of HbA1c ranging from 6 to 8
3. Poorly controlled diabetes patients (HbA1c values >8) indicated for periodontal surgical procedures shall be placed on SPT with maintenance recall visits every 1–2 months and should be advised stringent home care. Such patients can undergo planned periodontal surgical procedures once their HbA1c levels are in the range of 6–8
4. HbA1c levels above 8 call for an active intervention by medical professionals to review the medical management of the diabetic status of the patient
5. No surgical periodontal therapy, except emergency treatment, is recommended in patients with uncontrolled diabetes (HbA1c >10) with periodontal disease
6. A personalized case-to-case tailored meticulous periodontal treatment planning and preparedness of the dental office, based on the systemic condition, are needed for the clinical management of diabetes patients with periodontal disease.

Q28: Does bacteremia pose a significant challenge in managing the diabetes patients in the dental clinic for dental procedures? What would be the ways to manage it?

Evidence for bacteremia in the management of diabetes patients

There is no/minimal evidence in support of persistent bacteremia in diabetes patients. Transient bacteremia may occur in both controlled and uncontrolled diabetes patients. Literature suggests that the detection of bacteria

drops off sharply after 10 min after a dental procedure. The duration of bacteremia likely reflects the nature and the number of bacteria that enter the circulation, whether commensals predominate or pathogens predominate, and multiple other host factors such as immune responses.[9,10] It is difficult to quantify the magnitude of bacteria that initially gain entry into the circulation after dental procedures, owing to the factors such as heart rate, blood volume, proximity of the blood collection site to the source of the bacteremia, and rapid bacterial clearance by the reticuloendothelial system.[11]

Management of bacteremia in diabetes patients

Existing evidence does not support the extensive use of antibiotic prophylaxis for patients with diabetes; bacteremia following routine dental operative procedures is transient and unlikely to cause significant susceptibility to distant infections. Hence, the management of systemic antibiotics can be limited to a case-by-case basis after patient evaluation, keeping in mind the emergence of antibiotic resistance with indiscriminate use of antibiotics.[3,4,11] However, the use of a preprocedural, antiseptic mouth rinse proved to be efficacious in clinical trials, and it appears to be an effective method to reduce the microbial load of the oral cavity, further reducing the potential infectivity of the transient bacteremia elicited. Chlorhexidine, which has substantive properties, has been documented for a prolonged suppressive effect (up to 5–7 h) on oral microorganisms.[12,13] Mouth rinses with a short duration of action may allow oral microorganisms to return to their original levels within the operative duration in some dental procedures, thus limiting their application as a preprocedural rinse.

Recommendations

1. A mandatory preprocedural mouth rinse with chlorhexidine (nonalcohol-based) 0.12% (15 mL) or 0.2% (10 mL) should be used for 1 min before any dental operative procedure to reduce the microbial burden of the oral cavity and the associated infective potential of the transient bacteremia in patients with diabetes
2. Routine use of preoperative antibiotic prophylaxis to prevent bacteremia in diabetes patients undergoing dental procedures is not advocated
3. The decision to use preoperative antibiotic prophylaxis in diabetes patients undergoing dental procedures should be made on an individual case basis, keeping in mind the systemic status of the patient and the concerns regarding the emergence of antibiotic resistance with indiscriminate use of antibiotics.

Q29: Can nonsurgical periodontal therapy be instituted in all cases, irrespective of the glycemic status, as a part of the active inflammation control regimen?

There is sufficient evidence available in the literature suggestive of the institution of NSPT in all diabetes patients with periodontal disease, irrespective of the glycemic level as a part of active inflammation control.[6,14,15] Further, it is indicated that in people with diabetes, periodontal therapy accompanied by effective home care is both safe and effective.[16] Clinical periodontal parameters and local inflammatory measures improve following the standard nonsurgical therapy even in people with poorly controlled diabetes.[6,14-24]

Recommendation

1. NSPT shall be instituted in all diabetes patients with periodontal disease, irrespective of the glycemic level, as a part of active inflammation control at the time of the visit.

Q30: Would the adjuvant use of antibiotics (systemic/local) provide more benefit than standalone procedure of nonsurgical periodontal therapy? Further, would acute conditions and associated bacteremia be seen differently as far as the role of antibiotic coverage is concerned?

There is no direct evidence to recommend a specific protocol for the use of adjunctive systemic antimicrobials with nonsurgical mechanical debridement.[25] The use of systemic antibiotics as an adjunct therapy along with NSPT must weigh the risk–benefit ratio in terms of the potential side effects against the clinical benefit of reduction in the periodontal probing depth. The decision should be made depending on the individual periodontal destruction severity and be restricted to the most severe cases. This is in line with the current recommendations for the treatment of patients with chronic periodontitis.[6,26,27] Periodontal abscess is one of the most common emergencies encountered in dental practice, especially in diabetes patients. Several treatment protocols have been recommended, but sufficient scientific evidence is not available to recommend a definitive treatment modality.[28] Drainage and debridement should be the treatment of choice when the systemic condition and access to the abscess are adequate. If drainage cannot be performed immediately, then possible systemic antibiotics may be advised if a clear systemic involvement is evident.[28-31] In cases where the infection is not well localized or drainage cannot be instituted or there is a need for premedication, then only the use of systemic antimicrobials alone as an initial treatment is advocated.[31] The duration of therapy with antimicrobials is generally shorter.[31,32]

Recommendations

1. Adjuvant antibiotics are not recommended to be used along with NSPT in diabetes patients if the patient is otherwise fit to undergo treatment

2. The initial treatment for abscess should be drainage and debridement. The necessity for systemic antimicrobial therapy should be based on local and systemic considerations. As the prevalence of abscess is higher in untreated periodontitis cases, especially in those with diabetes, treatment of the acute phase should always precede before the definitive treatment of the pre-existing disease.

Q31: Are there any glycemic levels that would warrant no immediate surgical periodontal therapy? In such patients where surgery is deferred, should there be a customized maintenance protocol until they are deemed fit for periodontal surgery?

Glycemic levels in terms of HbA1c levels and mean blood sugar level on the day of surgery would be the most important determinants for elective surgical procedures if the patient is otherwise fit to undergo surgical treatment.[1-3] Blood sugar levels have profound effects on the postsurgical healing phase.[1,3] Patients with HbA1c levels ranging from 6 to 8 have no greater risk of postoperative infection than those without diabetes.[1,7,8] As there is an increased risk of periodontal disease in poorly controlled diabetes patients, individuals with periodontal disease who have HbA1c values above 8 should be advised active maintenance therapy after NSPT. This should include meticulous evaluation of a patient's periodontal status, frequent oral prophylaxis, oral hygiene instruction reinforcement, and consistent supervision of periodontal health.[1-3] Some studies have demonstrated continued periodontal destruction even if metabolic conditions improve,thus a more frequent recall is advisable.[3] Dentists should not delay NSPT in patients with diabetes waiting for metabolic control to be achieved.[6]

Recommendations

The surgical periodontal therapy can be safely performed in a diabetes individual if:

1. The recent HbA1c is within the range of 6%–8% if the patient is otherwise fit to undergo surgical treatment
2. The fasting blood glucose levels on the day of surgery are under 180 mg/dL (10 mmol/L) or random blood glucose levels of 200 mg/dL (11 mmol/L)
3. It is advisable not to perform any emergency surgical procedure if the random blood glucose level is >234 mg/dL (13 mmol/L)
4. Patients who cannot undergo surgical procedures, because either the recent Hb1Ac levels or mean glucose levels are not within the suggested range for surgical treatment, should be provided NSPT and active maintenance therapy until the patient achieves the desired glucose levels to be deemed fit for periodontal surgery
5. Subsequently, a recall schedule of 2–3 months should be recommended once glycemic control in poorly controlled diabetes patients is achieved
6. Preprocedural oral rinse with chlorhexidine (nonalcohol-based) 0.12% (15 mL) or 0.2% (10 mL) is recommended in all cases
7. For home oral care, correct tooth brushing, use of appropriate interdental aids, and toothpaste free of sodium laurel sulfate (SLS) are advisable. An oral rinse (nonalcohol-based) can be advocated.

Q32: What are perioperative and postoperative considerations for surgical periodontal therapy in diabetes patients?

It is generally advisable to assess the patient's blood glucose before surgery to ascertain that random blood glucose levels are within the recommended range. Periodontal surgery should be scheduled in the morning after breakfast and administration of the ongoing medication.[2,3] Short morning appointments are advisable. Patient anxiety and stress should be managed to minimize endogenous epinephrine release, as it can lead to hyperglycemia because of its counter-regulatory effect on the action of insulin.[2]

Dental appointment scheduling should consider the importance of nutritional consistency and should not overlap with or prevent scheduled meals. Patients receiving insulin, sulfonylurea, or meglitinides oral therapy may be at risk of hypoglycemia if the scheduled meal is missed because of dental appointment. A consultation with the patient's diabetologist to modify the diabetic regimen should be advocated if dental treatment is likely to lead to the changes in meal timings.[1] The timing of appointment should be before the peak activity of the therapeutic agent that is taken by a patient for diabetes.[33] The patient should be pre-rinsed with chemical plaque control agents such as chlorhexidine to reduce the incidence of bacteremia in blood during invasive surgical procedures.[13] Treatment procedures should be short (2 h or less) and as atraumatic as possible. The blood glucose level should be monitored every 2 h if the surgical procedures are of a longer duration and should not significantly interfere with the patient's normal dietary intake.[3] Patients with diabetes who have undergone periodontal surgical procedures should be given dietary instructions after surgery. It is important to maintain good glycemic control in the postoperative period as it has a profound effect on the healing pattern.[33] Postoperative management should include meticulous infection and pain control.[33] A postoperative follow-up examination to rule out any impending infections or associated complications should be scheduled to assess the healing of the surgical area.

Recommendations

1. It is recommended to check for mean blood sugar levels on the day of surgery (before and after). Intraoperative glucose monitoring with a chair-side glucometer is recommended if procedures are longer than 2 h
2. Adequate knowledge of patients' diabetic regimen should help the dentist to avoid peak time effects of drugs for dental appointment scheduling
3. Pre-rinse to reduce bacteremia during the surgical procedure is indicated
4. Postoperative diet counseling should be performed, and patients should be advised to maintain blood sugar levels within the targeted levels to achieve better results
5. An assessment of postoperative healing is advocated to check for any signs of impending infections and pain in the surgical wound area.

Q33: Are implants or periodontal regenerative procedures viable treatment options for a diabetes patient as compared to a nondiabetes patient?

There is strong evidence supporting the use of dental implants as a viable treatment option in well-controlled diabetes patients, as the success rate has been documented at par or marginally lower than that in nondiabetes individuals. Retrospective and prospective studies reported an 85.5%–100% success rate of dental implants in well-controlled diabetes patients, which was in concordance with the success rates observed in nondiabetes patients.[34-41] Good glycemic control, preoperative antiseptic rinse, and postoperative control of infections have been documented as the significant determinants to achieve improved osseointegration in diabetes patients.[42] However, in poorly controlled diabetes patients, a higher failure rate has been observed during the 1st year of functional loading, seemingly pointing to the microvascular complications of this condition as a possible causal factor. These complications may compromise the healing of soft tissues and a reduction in the levels of bone–implant contact.[34,35] Such clinical situations may be prevented and/or reversed by the maintenance of good glycemic control, specifically during the early postoperative period of healing vital for achieving the osseointegration of the implant fixture.[43]

There is a lack of evidence suggestive of the detrimental impact on the outcomes of periodontal regenerative procedures in patients with well-controlled diabetes. There is some anecdotal evidence available regarding the outcome of periodontal regenerative procedures in diabetes patients as case reports, which emphasizes the significance of good glycemic control as an important factor influencing the periodontal regenerative outcomes.[44,45] The outcomes of regenerative periodontal procedures in well-controlled diabetes have been documented as comparable to those achieved in nondiabetes individuals. Poor glycemic control, however, has been considered a relative contraindication for undergoing periodontal surgical therapy, in general, and may delay the institution of surgical procedure, until a good glycemic control is achieved.

Recommendations

1. Dental implants and periodontal regenerative procedures are viable treatment options for well-controlled diabetes patients
2. To enhance the predictability of successful outcomes of the above-mentioned treatment options in diabetes patients, stringent maintenance of glycemic control (near-normal glucose levels) is a prerequisite
3. Preprocedural antiseptic mouth rinse (chlorhexidine [nonalcohol-based]) 0.12% (15 mL) or 0.2% (10 mL) for 1 min and postoperative control of impending infections are very important in the management of diabetes patients undergoing implantation and periodontal regenerative procedures
4. Long-term successful outcomes of dental implants and periodontal regenerative procedures in diabetes patients should be enhanced by active supportive periodontal therapy (periodic professional assessment at 2–3 months and rigorous oral hygiene maintenance home care) for the 1st year posttreatment.

Q34: What should be the maintenance protocol in terms of follow-up intervals and home care adjuvants in diabetes patients? What are the chances of recurrence of periodontal disease in the maintenance phase? Is there a need for custom designing a supportive periodontal therapy protocol based on the clinical outcomes and systemic glycemic status?

There is a strong evidence base for independent associations between periodontitis and type 2 diabetes, with a dual directionality of influence reported.[46] In diabetes patients with periodontal disease, hyperglycemia is associated with an increased risk and severity of periodontitis and poorer periodontal outcomes following periodontal therapy.[47,48] Short-term effects of periodontal treatment are similar in diabetes patients and healthy populations,[20,49,50] but more recurrence of periodontal disease can be expected in nonwell-controlled diabetes individuals.[51,52] Periodontal therapy followed by more frequent recall visits and maintenance procedures accompanied by effective home care has been documented to be both safe and effective for the management of periodontal disease in these patients.[16] Most of studies suggest a more frequent, closer recall system for periodic professional assessment of these patients for the early diagnosis and management of ensuing periodontal complications, if any.[1-3] A custom maintenance protocol at intervals (2–3 months) necessary to maintain a high level of periodontal health on an individual basis is desired to be designed keeping in view the systemic and oral health status of diabetes patients.[15,53] Poorly controlled diabetes patients should specifically be advised to receive a modified active supportive periodontal therapy protocol with even frequent recalls, based

on the periodontal risk assessment, response to NSPT, compliance with oral hygiene and maintenance, and systemic glycemic status.[1-3,15,53]

Recommendations

1. All DM patients should be encouraged to maintain meticulous oral hygiene and receive customized supportive periodontal therapy at intervals necessary to maintain good periodontal health
2. A well-controlled diabetes patient has no greater susceptibility for the recurrence of periodontal disease as compared to a nondiabetes individual
3. Poorly controlled diabetes patients need to be maintained by participation in active supportive periodontal therapy intervals to prevent recurrent periodontal disease episodes
4. Well-controlled type 1 or type 2 diabetes with successful periodontal therapy can be maintained in supportive periodontal therapy intervals (2–3 months) based on the periodontal risk assessment and systemic glycemic status
5. Poorly controlled diabetes patients with periodontal disease shall be followed up by periodic professional assessment at 1–2 months for the 1st year, post-nonsurgical periodontal treatment. After achieving good glycemic control and subsequent completion of the periodontal treatment, these patients may then be maintained by participation in the supportive periodontal therapy intervals (2–3 months) based on the periodontal risk assessment and systemic glycemic status
6. In case of a major dental procedure in a diabetes patient, under moderate or poor control, follow-up with the diabetologist or dentist should be conducted within 2–4 weeks
7. Keeping in view the altered local oral environment in diabetes patients, specific oral home care instructions such as the use of antiseptic mouthwashes (chlorhexidine [nonalcohol-based]) 0.12% (15 mL) or 0.2% (10 mL), subgingival irrigation, sugar, and SLS-free oral healthcare products (dentifrices and mouth rinses) may be prescribed for routine oral health maintenance.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. McKenna SJ. Dental management of patients with diabetes. Dent Clin North Am 2006;50:591-606, vii.
2. Vernillo AT. Dental considerations for the treatment of patients with diabetes mellitus. J Am Dent Assoc 2003;134 Spec No: 24S-33S.
3. Rees TD. Periodontal management of the patient with diabetes mellitus. Periodontol 2000 2000;23:63-72.
4. Mealey BL. Periodontal implications: Medically compromised patients. Ann Periodontol 1996;1:256-321.
5. Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F, *et al*. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International Diabetes Federation and the European Federation of Periodontology. J Clin Periodontol 2018;45:138-49.
6. Kocher T, König J, Borgnakke WS, Pink C, Meisel P. Periodontal complications of hyperglycaemia/diabetes mellitus: Epidemiologic complexity and clinical challenge. Periodontol 2000 2018;78:59-97.
7. Cosson E, Catargi B, Cheisson G, Jacqueminet S, Ichai C, Leguerrier AM, *et al*. Practical management of diabetes patients before, during and after surgery: A joint French Diabetology and Anaesthesiology Position Statement. Diabetes Metab 2018;44:200-16.
8. Gazal G. Management of an emergency tooth extraction in diabetic patients on the dental chair. Saudi Dent J 2020;32:1-6.
9. Lockhart PB, Brennan MT, Thornhill M, Michalowicz BS, Noll J, Bahrani-Mougeot FK, *et al*. Poor oral hygiene as a risk factor for infective endocarditis-related bacteremia. J Am Dent Assoc 2009;140:1238-44.
10. Lockhart PB, Brennan MT, Sasser HC, Fox PC, Paster BJ, Bahrani-Mougeot FK. Bacteremia associated with toothbrushing and dental extraction. Circulation 2008;117:3118-25.
11. Wilson W, Taubert KA, Gewitz M, Lockhart PB, Baddour LM, Levison M, *et al*. Prevention of infective endocarditis: Guidelines from the American Heart Association: A guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. Circulation 2007;116:1736-54.
12. Yaghmoor W, Ogata Y, Hanley J, Finkelmen M, Kawai T, Hur Y. Use of pre-operative mouthwash in dental treatment: A literature review. Charlotte, N.C., USA: American Association for Dental Research Annual Meeting & Exhibition; 2014.
13. Kosutic D, Uglesic V, Perkovic D, Persic Z, Solman L, Lupi-Ferandin S, *et al*. Preoperative antiseptics in clean/contaminated maxillofacial and oral surgery: Prospective randomized study. Int J Oral Maxillofac Surg 2009;38:160-5.
14. Hasturk H, Manosudprasit A, Stephens D, Sherzai H, Kantarci A, Van Dyke TE. Serum biomarkers in response to periodontal treatment in type 2 diabetes mellitus. J Dent Res 2014;93(Spec Iss B):1425.

15. Genco RJ, Graziani F, Hasturk H. Effects of periodontal disease on glycemic control, complications, and incidence of diabetes mellitus. Periodontol 2000 2020;83:59-65.
16. Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F, *et al*. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International diabetes Federation and the European Federation of Periodontology. Diabetes Res Clin Pract 2018;137:231-41.
17. Janket SJ, Wightman A, Baird AE, Van Dyke TE, Jones JA. Does periodontal treatment improve glycemic control in diabetic patients? A meta-analysis of intervention studies. J Dent Res 2005;84:1154-9.
18. Corbella S, Francetti L, Taschieri S, De Siena F, Fabbro MD. Effect of periodontal treatment on glycemic control of patients with diabetes: A systematic review and meta-analysis. J Diabetes Investig 2013;4:502-9.
19. Engebretson S, Kocher T. Evidence that periodontal treatment improves diabetes outcomes: A systematic review and meta-analysis. J Clin Periodontol 2013;40 Suppl 14:S153-63.
20. Smith GT, Greenbaum CJ, Johnson BD, Persson GR. Short-term responses to periodontal therapy in insulin-dependent diabetic patients. J Periodontol 1996;67:794-802.
21. Wang X, Han X, Guo X, Luo X, Wang D. The effect of periodontal treatment on hemoglobin A1c levels of diabetic patients: A systematic review and meta-analysis. PLoS One 2014;9:e108412.
22. Lima RP, Belém FV, Abreu LG, Cunha FA, Cota LO, da Costa JE, *et al*. Effect of periodontal therapy on serum levels of IL-6 in type 2 diabetics: A systematic review. Int J Periodontics Restorative Dent 2019;39:e1-10.
23. Artese HP, Foz AM, Rabelo Mde S, Gomes GH, Orlandi M, Suvan J, *et al*. Periodontal therapy and systemic inflammation in type 2 diabetes mellitus: A meta-analysis. PLoS One 2015;10:e0128344.
24. Borgnakke WS. IDF Diabetes Atlas: Diabetes and oral health-A two-way relationship of clinical importance. Diabetes Res Clin Pract 2019;157:107839.
25. Herrera D, Alonso B, León R, Roldán S, Sanz M. Antimicrobial therapy in periodontitis: The use of systemic antimicrobials against the subgingival biofilm. J Clin Periodontol 2008;35:45-66.
26. Harks I, Koch R, Eickholz P, Hoffmann T, Kim TS, Kocher T, *et al*. Is progression of periodontitis relevantly influenced by systemic antibiotics? A clinical randomized trial. J Clin Periodontol 2015;42:832-42.
27. Smiley CJ, Tracy SL, Abt E, Michalowicz BS, John MT, Gunsolley J, *et al*. Systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts. J Am Dent Assoc 2015;146:508-24.
28. Herrera D, Alonso B, de Arriba L, Santa Cruz I, Serrano C, Sanz M. Acute periodontal lesions. Periodontol 2000 2014;65:149-77.
29. Ahl DR, Hilgeman JL, Snyder JD. Periodontal emergencies. Dent Clin North Am 1986;30:459-72.
30. DeWitt GV, Cobb CM, Killoy WJ. The acute periodontal abscess: Microbial penetration of the soft tissue wall. Int J Periodontics Restorative Dent 1985;5:38-51.
31. Lewis MA, McGowan DA, MacFarlane TW. 'Short-course high-dosage amoxycillin in the treatment of acute dentoalveolar abscess'. Br Dent J 1987;162:175.
32. Martin MV, Longman LP, Hill JB, Hardy P. Acute dentoalveolar infections: An investigation of the duration of antibiotic therapy. Br Dent J 1997;183:135-7.
33. Miley DD, Terezhalmy GT. The patient with diabetes mellitus: Etiology, epidemiology, principles of medical management, oral disease burden, and principles of dental management. Quintessence Int 2005;36:779-95.
34. Oates TW, Dowell S, Robinson M, McMahan CA. Glycemic control and implant stabilization in type 2 diabetes mellitus. J Dent Res 2009;88:367-71.
35. Dowell S, Oates TW, Robinson M. Implant success in people with type 2 diabetes mellitus with varying glycemic control: A pilot study. J Am Dent Assoc 2007;138:355-61.
36. Balshi TJ, Wolfinger GJ. Dental implants in the diabetic patient: A retrospective study. Implant Dent 1999;8:355-9.
37. Morris HF, Ochi S, Winkler S. Implant survival in patients with type 2 diabetes: Placement to 36 months. Ann Periodontol 2000;5:157-65.
38. Fiorellini JP, Chen PK, Nevins M, Nevins ML. A retrospective study of dental implants in diabetic patients. Int J Periodontics Restorative Dent 2000;20:366-73.
39. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Failure patterns of four osseointegrated oral implant systems. J Mater Sci Mater Med 1997;8:843-7.
40. Olson JW, Shernoff AF, Tarlow JL, Colwell JA, Scheetz JP, Bingham SF. Dental endosseous implant assessments in a type 2 diabetic population: A prospective study. Int J Oral Maxillofac Implants 2000;15:811-8.
41. Tawil G, Younan R, Azar P, Sleilati G. Conventional and advanced implant treatment in the type II diabetic patient: Surgical protocol and long-term clinical results. Int J Oral Maxillofac Implants 2008;23:744-52.
42. Ciancio SG, Lauciello F, Shibly O, Vitello M, Mather M. The effect of an antiseptic mouthrinse on implant maintenance: Plaque and peri-implant gingival tissues. J Periodontol 1995;66:962-5.
43. Loo WT, Jin LJ, Cheung MN, Wang M. The impact of diabetes on the success of dental implants and periodontal healing. Afr J Biotechnol 2009;8:5122-7.
44. Mattson JS, Cerutis DR, Parrish LC. Complications associated with diabetes mellitus after guided tissue regeneration--A case report revisited. Compend Contin Educ Dent 2002;23:1135-8, 1140, 1142 passim.
45. Seshima F, Nishina M, Namba T, Saito A. Periodontal regenerative therapy in patient with chronic periodontitis and type 2 diabetes mellitus: A case report. Bull Tokyo Dent Coll 2016;57:97-104.
46. Taylor GW. Bidirectional interrelationships between diabetes and periodontal diseases: An epidemiologic perspective. Ann Periodontol 2001;6:99-112.
47. Lalla E, Cheng B, Lal S, Tucker S, Greenberg E, Goland R, *et al*. Periodontal changes in children and adolescents with diabetes: A case-control study. Diabetes Care 2006;29:295-9.

48. Mealey BL. Periodontal disease and diabetes. A two-way street. J Am Dent Assoc 2006;137 Suppl: 26S-31S.
49. Llambés F, Silvestre FJ, Hernández-Mijares A, Guiha R, Caffesse R. The effect of periodontal treatment on metabolic control of type 1 diabetes mellitus. Clin Oral Investig 2008;12:337-43.
50. Faria-Almeida R, Navarro A, Bascones A. Clinical and metabolic changes after conventional treatment of type 2 diabetic patients with chronic periodontitis. J Periodontol 2006;77:591-8.
51. Bascones-Martínez A, Muñoz-Corcuera M, Bascones-Ilundain J. Diabetes and periodontitis: A bidirectional relationship. Med Clin (Barc) 2015;145:31-5.
52. Llambés F, Arias-Herrera S, Caffesse R. Relationship between diabetes and periodontal infection. World J Diabetes 2015;6:927-35.
53. Mealey BL. Management of the diabetic patient. In: Harpenau LA, Kao RK, Lundergan WP, Sanz M, editors. Hall's Critical Decisions in Periodontology and Dental Implantology. 5th ed. Shelton Connecticut, USA: People's Medical Publishing House; 2013. p. 148-50.

Table 1: Preoperative management of patients with diabetes - Regarding the use of oral antidiabetic drugs

	Ambulatory surgery	Nonambulatory surgery (minor or major surgery)	Emergency surgery
Metformin	Continue	Avoid taking the drug on day 1 (evening) and D0 (morning)	Stop
Sulfonylureas	Continue	Avoid taking the drug on D0 (morning)	Stop
Glinides	Continue	Avoid taking on D0 (morning)	Stop
Alpha glucosidase inhibitors	Continue	Avoid taking on D0 (morning)	Stop
DPP-4 inhibitors	Continue	Avoid taking on D0 (morning)	Stop
SGLT2-inhibitors	Continue	Avoid taking on D0 (morning)	Stop
GLP-1 analogs	Continue	Avoid taking on D0 (morning)	Stop
SC insulin injection	Continue	No drug injection on the morning of D0 except for T1DM	Stop
Insulin pump	Continue	Stop the insulin pump on arrival in the OR	Stop

Source: Cosson *et al*.[24] D−1 – Day before surgery; D0 – Day of surgery; SC – Subcutaneous; T1DM – Type 1 diabetes mellitus; OR – Operating room; DPP-4 – Dipeptidyl peptidase-4; SGLT2 – Sodium-glucose co-transporter 2; GLP – Glucagon-like peptide

Table 2: Preoperative management of patients with diabetes - Regarding the use of insulin

Insulin type	Time of onset	Duration	Peak effect
Rapid-acting			
Lispro	10-30 min	3-5 h	30-60 min
Aspart	10-30 min	3-5 h	30-60 min
Glulisine	10-30 min	3-5 h	2 h
Short-acting			
Regular human insulin	30-60 min	5-12 h	1.5-2 h
Intermediate-acting			
NPH, Lente	1-2 h	10-20 h	4-8 h
Long-acting			

Ultralente	2-4 h	16-24 h	8-20 h
Glargine	Up to 6 h	Up to 24 h	No peak
Detemir	2-4 h	20 h	No peak
Degludec	0.5-1.5 h	Up to 48 h	No peak
Gla-300	Up to 6 h	Up to 36 h	No peak

Source: McKenna.[25] NPH – Neutral protamine Hagedorn

Table 3: Hypoglycemia: Signs, symptoms, and management during a dental operative procedure

Signs and symptoms	**Emergency treatment**
Mild	Stop the operative dental treatment immediately
Hunger	Awake/alert patient
Fatigue	Administer 15 g of oral carbohydrate (i.e., glucose tablets or gel or powder, 180 mL of orange juice, 15-25 mL of sugar water)
Sweating	
Nausea	
Abdominal pain	
Headache	Monitor blood glucose and repeat carbohydrate dosing as necessary
Tachycardia	
Irritability	Uncooperative patient
Moderate	Seek emergency medical assistance
Incoherence	
Uncooperative	Administer 20-50 mL of 50% dextrose solution intravenously
Belligerence	
Resistive behavior	Administer glucagon 1 mg as available subcutaneously or intramuscularly, followed by oral glucose supplement, especially in type 1 diabetes patients and those on insulin therapy. It should be avoided in those on sulfonylurea therapy
Severe	
Unconsciousness	
Seizures	
	Unconscious patient
	Seek emergency medical assistance
	Administer 20-50 mL of 50% dextrose solution

Source: McKenna[25]

VISION STATEMENT

To be recognized as a global leader for clinical care, education, training, research, advocacy and capacity building in the field of diabetes.

MISSION STATEMENT

1. Promotion of excellence in diabetes care to make India the Diabetes Care Capital.
2. Empowerment of persons living with diabetes.
3. Support for diabetes research.
4. Dissemination of information and knowledge in diabetes care.
5. Advocacy for the cause of diabetology.

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Research Grants upto INR 200000 to support outstanding thesis/ research work by first year MD/DNB/ PHD students/Research fellows from India.

Eligibility Criteria
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How to apply?
Send in your Research proposals by email to the RSSDI Secretary Chairman research committee by email/ apply directly on web site.

Research proposal should have following proofs-

1. A supporting letter from your guide/ head of department stating that this is a bonafide project for your thesis and also mentioning the dates of you joining the program and expected date of graduation. The guide must also state that he/she will stand guarantee for the work done.
2. A detailed budget.
3. Thesis proposal approved by the department/appropriate institutional authority.
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Proposals will be reviewed by the research committee of the RSSDI.

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A minimum of 50% of the grant amount will be disbursed initially. Further disbursement will be done annually based on submission of progress reports on the work done and utilisation of sanctioned amount. These reports must be filed to the secretary of the RSSDI.

Responsibility:
All grant awardees are expected to present their work at RSSDI Annual Conference during research presentation's session. Failure to file progress reports annually and when requested by the RSSDI and failure to present progress at RSSDI Annual Conference may result in the forfeiture of the grant.

All awardees are expected to follow the tenets of responsible and ethical conduct of research. Unethical or fraudulent use of RSSDI research funds will warrant adverse action from the society including forfeiture of grant, black listing in the society's databases and other legal recourses that are available to the society.

Publication
The RSSDI expects that the grant source be acknowledged in all publications and submissions made with regards to the research done with the grant.

All awardees are encouraged to submit their work to the RSDDI Journal International Journal of Diabetes in Developing Countries.

CALL FOR RESEARCH PROPOSALS FOR GRANTS (up to 5 lacs)

Research proposals are invited from Indian scientists, who are members of RSSDI interested in conducting research in the field of Diabetes, Endocrinology& Metabolism, for funding by RSSDI.

The proposals may be of clinical or translational research importance. A maximum grant amount of INR 5 Lakhs will be sanctioned. All grants will be reviewed by the research committee.

The detailed proposals should include the following:
Title, names of principal and co investigators, summary, introduction/ background, review of literature, aims, methodology, study design and detailed plan of work & bibliography.

Brief biodata of principal investigator and other co-investigators.

Importance of work
Detailed Budget sought along with full justification/ proposed utilization of funding sought from RSSDI.

Whether the project is being partly funded from any other source? If yes, please mention the source and the amount received.

Ethics Committee clearance of the Institution or other bonafide body.

How to apply
All applications should be addressed to:
1. The Secretary , RSSDI.
2. Soft copy of the research proposal should be sent to Secretary, RSSDI.

When to apply
Proposals will be accepted Twice a year. Once between 1st Jan - 31st April & then July 1st to 30th Nov.

All research proposals will be reviewed by Research committee over a period of 4-6 weeks & approved proposals will be provided Research Grant after fulfilling all documentation by 30th June & then 31st December of each year.

MAJOR RESEARCH GRANT PROPOSALS- usually not more than one at a given time.

Above 10 Lacs upto a total amount of 50 Lacs will be Granted to RSSDI initiated, owned, multi-centric, clinical or translational research, having long term application of scientific and clinical findings, which can translate into strategies for improving health care delivery, patient outcomes, and community health in India.

Such research proposals will be carried out in only centres with research capabilities across India.

TRAVEL GRANTS FOR YOUNG DIABETES RESEARCHERS TO ATTEND INTERNATIONAL CONFERENCES

Criteria for the travel grant are as follows:

- Applicant should apply 2 months in advance.
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- Applicant should submit Oral paper / Poster acceptance document to RSSDI Secretariat.
- Applicant should submit Declaration that he/she has not receiving grant from any other agency / Organization – In case of receiving grant from any other Organization, RSSDI shall pay only the exceeding amount not covered by that agency.

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(IN ASSOCIATION WITH JAIPUR NATIONAL UNIVERSITY)

Research Society for the Study of Diabetes in India (RSSDI) was founded by Prof.M.M.S. Ahuja in 1972. RSSDI is the largest body of professional doctors and researchers in Asia, working in the area of Diabetes & is the National Body recognized by IDF (International Diabetes Federation). One of the key areas of focus is to train doctors at all levels to better manage Diabetes and its complications. RSSDI recognizes this problem and runs a well-structured, full time, residential "Advanced Certificate Course in Diabetology". This two-year course is like any other post graduate course and has immensely helped doctors to practice better diabetes care. RSSDI has carefully looked into all aspects of this course & has accredited & recognized 18 centres across India at present and more centers are being inspected for accreditation. National Faculties and experts of RSSDI chosen from Academia visit these centers fromtime to time to ensure high standards. Now this Advanced Certificate Course has Dual Accreditation from RSSDI and Jaipur National University.

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6.	Sonal Diabetes Hospital	Surat, Gujrat
7.	Jothydev's Diabetes and Research Center	Trivandrum, Kerala
8.	Advanced Endocrine & Diabetes Hospital	Hyderabad, Telangana
9.	Sunil's Diabetes Care N' Research Centre	Nagpur, Maharashtra
10.	Marwari Hospital and Research Cenre	Guwahati, Assam
11.	Down Town Hospital	Guwahati, Assam
12.	St.Theresa's Hospital	Hyderabad, Telangana
13.	Aegle Clinic	Pune, Maharashtra
14.	Lilavati Hospital & Research Centre	Bandra West, Mumbai
15.	Srajan Hospital	Udaipur, Rajasthan
16.	Endeavour Clinics & Dr. Sambit's Centre of Diabetes and Endocrinology	Bhubaneswar, Odisha
17.	ILS Hospital, Salt Lake	Salt Lake City, Kolkata
18.	Belle Vue Clinic	Dr. U N Brahmachari Street, Kolkata

COURSE DETAILS

Name of the Course: Advanced Certificate Course in Diabetology

Duration: 2 Years – Post MBBS & 1 Year - Post MD / DNB (Gen - Medicine)* (Full Time) Educational.

Qualification: A candidate must possess MBBS degree from ANY of the recognized university approved by Medical Council of India (*The duration of the course is 1 Year for those with MD/ DNB in Internal Medicine. Candidates having MD degree in other specialties will have to do the course over 2 Years).

Number of seats: 2 seats per year for every eligible teacher as per rules of Medical Council of India (MCI).

Selection of Candidates: Selection for the Certificate course is through a performance evaluation by screening interview of 50 marks at respective Centres. This will be conducted by the local course Director. The result will be declared in a week's time.

COURSE FEES:

- Rs 30000/- (for post MD/DNB (internal medicine), 1-year program)
- Rs. 50000/- (for post MBBS,MDin other branches, 2-year program)

Session: Two sessions are run annually, in January and in July. Prospectus details are available on the RSSDI website. All applications must be sent to Jaipur National University.

ANNOUNCEMENTS

Dear Member,

Please update your Membership details like Complete Postal Address, Email Id, Pan No. & Mobile No. after logging in your membership area on our website www.rssdi.in under sub heading Membership Corner, so that we can send you RSSDI Newsletter & Journals.

48th Annual Conference of RSSDI –RSSDI 2020

Virtual Conference by National RSSDI EC Members on 26th - 29th November 2020

THEME: Practical, Clinical, Relevant

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