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Diabetes and periodontitis: current approach

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ABSTRACT

Diabetes is described as a systemic disease that manifests itself with many major complications that determine the quality of life. The chronic complications of diabetes have been defined as macro- and microvascular complications. In recent years, periodontitis has also been identified as one of these complications. Diabetes negatively affects oral and dental/gum health. Metabolic disorders in diabetic patients reduce the resistance of gum tissues to infection, thereby increasing the likelihood of gum disease. Impairment of oral and dental/gum health also disrupts blood sugar regulation in diabetic patients. Thus, the negative effect is two-way. The relationship between periodontitis and diabetes has also been observed in many studies. The aim of this study is to provide information about diabetes and periodontitis, explain the relationship between diabetes and periodontitis, and offer the best possible dental care and counseling to diabetic patients based on general dental knowledge.

Keywords: Diabetes, oral health, dental health, periodontitis

DIABETES MELLITUS

The guideline prepared by the Society of Endocrinology and Metabolism of Turkiye (SEMT) and frequently referred to in the follow-up and treatment of diabetes patients in our country defines diabetes mellitus (DM) as a chronic, broad-spectrum metabolic disorder that requires ongoing medical care.[1] Characterized by hyperglycemia, DM, according to the American Diabetes Association (ADA), arises due to hyperglycemia caused by insulin deficiency or defects in insulin action.[2]

Diabetes Diagnosis Criteria

- According to the current SEMT guidelines, one of the four diagnostic criteria is sufficient for a diagnosis of DM (SEMT, 2024).[1] These four diagnostic criteria are as follows:
- Fasting plasma glucose (FPG) level ≥126 mg/dl after ≥8 hours of fasting
- Oral glucose tolerance test (OGTT) 2-hour plasma glucose (PG) level ≥200 mg/dl
- The glycated hemoglobin A1c (HbA1c) level ≥6.5%.

If one of these three criteria is met, it must be confirmed by another criterion.

- Random plasma glucose level ≥200 mg/dl accompanied by diabetes symptoms (such as excessive eating, excessive thirst, and frequent urination). If this criterion is present, a diagnosis can be made.

Epidemiology

DM is a chronic health problem that has reached alarming levels worldwide. According to data from the International Diabetes Federation (IDF), in 2019, the estimated number of people with DM worldwide reached 463 million (9.3% prevalence) and resulted in 4.2 million deaths. It is projected that the prevalence of DM will rise to 9.9% by 2045, reaching 693 million people. In Turkiye, the TURDEP-II study conducted between 2009 and 2010 found that the prevalence of DM was 16.5%, with 6.5 million adults diagnosed with DM. Today, it is estimated that one in three patients has diabetes/prediabetes.[1-4]

Complications of Diabetes

The General Directorate of Health Services published the Turkiye Diabetes Prevention and Control Program Action Plan (2011-2014) as part of the Ministry of Health of the Republic of Turkiye's 2010-2014 Strategic Plan, which includes the sub-goal of "ensuring early diagnosis and treatment of diabetes and reducing the incidence of diabetes-related complications by the end of 2014." The aim of this plan is to ensure the early diagnosis and treatment of diabetes, raise public awareness of related risk factors, and reduce the incidence of diabetes-related complications to World Health Organization targets. Within the plan, the objective of "improving the quality of life of people with diabetes" is listed as the first activity under the target of "developing care services for people with diabetes," specifically "ensuring regular monitoring of oral and dental health for people with diabetes."[5-7]

Diabetes leads to many chronic complications.[1,6,7]

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Acute Complications of Diabetes

Acute complications of diabetes mellitus are classified under four main headings.

- Diabetic ketoacidosis
- Hyperosmolar hyperglycemic state
- Lactic acidosis
- Hypoglycemia

Chronic Complications of Diabetes

- **Macrovascular complications:** Atherosclerotic heart disease, cerebrovascular disease, and peripheral vascular disease
- **Microvascular complications:** Retinopathy, nephropathy, neuropathy

In recent years, periodontal diseases have also been considered one of the chronic complications of diabetes.[8-10]

PERIODONTAL MEDICINE

First published in 1891, the focal infection theory demonstrated that oral microorganisms and/or their products could reach other parts of the body (Miller, 1891).[11] Later, it was suggested that infected teeth could be a source of focal infection in certain diseases such as arthritis, rheumatism, nephritis, and endocarditis (Billings, 1914).[12] Those who supported this theory argued that dental plaque microorganisms and their metabolic products could enter the bloodstream and cause many systemic and some degenerative conditions. In the 1930s, it was observed that patients' systemic conditions did not improve even after the suspected source of focal infection was eliminated, and this theory began to be questioned. After 1990, the relationship between oral/periodontal infection and systemic health was investigated under the name "periodontal medicine." Periodontal medicine is defined as a discipline that investigates the two-way relationship between systemic health and periodontal disease and the possible mechanisms involved in this relationship.[11-13]

Gram-negative bacteria found in the subgingival area of individuals with periodontal disease are a constant and significant source of irritation for the host. Periodontal bacteria and their products (such as lipopolysaccharides) can mostly enter periodontal tissues and the circulation through ulcerated and disrupted sulcular epithelium. Inflammatory markers such as TNF-α, IL-1ß, prostaglandin E2 (PGE2), and γ-interferon are produced in inflamed gingival tissue; these can enter the bloodstream and contribute to the inflammatory load. Thus, while periodontal tissues mount an immune-inflammatory response to bacteria and their products, the systemic effects of these agents also result in a major vascular response. This may explain the relationship between periodontal disease and systemic diseases. Three mechanisms by which periodontal infection may affect systemic health have been identified;[10,13,14]

- Metastatic infection caused by translocation of gram-negative bacteria from the periodontal pocket into the bloodstream
- Metastatic injury such as vascular lesions caused by the effects of circulating microbial toxins and proinflammatory markers
- Metastatic inflammation associated with the immune response to periodontal pathogens and their products

In recent years, periodontal inflammation has been identified as a risk factor for the development and progression of various systemic diseases and conditions. The relationship between periodontal disease and DM, cardiovascular disease, chronic obstructive pulmonary disease, and adverse pregnancy outcomes (low birth weight babies and premature birth), as well as its relationship with diseases and conditions such as obesity, metabolic syndrome, rheumatoid arthritis, chronic kidney disease, and cancer, are being investigated, along with the possible mechanisms involved.[15-19]

THE RELATIONSHIP BETWEEN DIABETES MELLITUS AND PERIODONTITIS

There is a bidirectional relationship between DM and periodontal diseases due to DM being a risk factor for periodontal diseases because it increases the prevalence and severity of periodontitis, and periodontitis making glycemic control difficult.[9,10]

Both periodontal disease and T2DM have been reported to have genetic factors. Periodontitis has been reported to be a complication of DM. DM is a major risk factor for periodontitis. It has been shown that the severity and prevalence of periodontal disease increase in individuals with DM. Metabolic control of DM may be an important variable in the onset and progression of periodontal disease. Many studies have found that the risk of developing periodontal disease is much higher in individuals with DM compared to those without DM. Improvements in metabolic status in individuals with T2DM positively affect periodontal health, while metabolic control is positively affected in individuals with DM who undergo periodontal treatment. Bleeding after periodontal procedures decreases with improved glycemic control. Most comprehensive meta-analyses have concluded that adults with DM have more severe periodontal disease compared to adults without DM. DM has been associated with an increased risk of periodontitis even at a young age.[10,15-19]

The Effect of Diabetes Mellitus on Periodontal Disease

Many of the mechanisms involved are similar to those of microvascular and macrovascular complications. In addition, hyperglycemia observed in DM may cause the activation of pathways that increase inflammation, oxidative stress, and apoptosis. Structural components such as proteins, lipids, and nucleic acids in our body undergo glycation with monosaccharides such as fructose, galactose, and glucose. Glycation, an irreversible process, occurs spontaneously and results in the formation of advanced glycation end products (AGEs). AGEs accumulate in cells and tissues, forming cross-links with other protein and lipid molecules, which leads to the inactivation of structures and functional impairment. The receptors targeted by AGEs in structures such as smooth muscle cells, endothelial cells, monocytes, and fibroblasts are called RAGE (receptor for AGE) and exert their effects by forming a dimer structure called AGE-RAGE. RAGE is synthesized in small amounts in healthy individuals but increases in individuals with DM. Hyperglycemia triggers a series of immune responses through the production of AGEs. The binding of AGEs to their receptors leads to increased production of inflammatory markers such as IL-1ß, TNF-α, and IL-6. AGE formation increases oxidative stress by causing the production of reactive oxygen species, and the resulting

endothelial cell changes contribute to vascular damage, which plays a role in many diabetic complications. AGEs exhibit harmful effects on bone metabolism by causing impaired tissue repair and bone formation and reduced extracellular matrix production. In conclusion, hyperglycemia causes AGEs to accumulate in periodontal tissues and bind to the AGE receptor, leading to the release of local cytokines and subsequent changes in inflammatory responses. As the inflammatory response persists, an increase in periodontal and bone destruction is observed. In DM, neutrophil chemotaxis and phagocytosis are impaired, and bacterial retention, which causes destruction of periodontal tissues, is increased. In DM, although neutrophil function is reduced, an increase in DOS monocyte and macrophage counts is observed. This increase leads to elevated levels of pro-inflammatory cytokines such as TNF-α, IL-1, and IL-6, contributing to increased periodontal tissue destruction in individuals with DM. The abnormal host defense observed in individuals with DM, in addition to hyperglycemic status, contributes to the proliferation of periodontopathogens in gingival crevicular fluid (GCF) and saliva. With increasing severity of DM, an increase in periodontal abscess formation and tooth loss due to periodontal destruction is observed. DM also has a significant effect on collagen metabolism; in the presence of hyperglycemia, the maturation and homeostatic turnover of collagen produced by fibroblasts is impaired, resulting in a decrease in the amount of newly produced collagen. The newly formed collagen is not very strong and is highly susceptible to degradation by certain matrix metalloproteinases, such as collagenase. Existing collagen forms structures that cannot be dissolved by AGEs, leading to collagen imbalance and delayed, inadequate tissue healing in periodontal disease.[17,18,20]

The Effect of Periodontitis on Diabetes Mellitus

Periodontitis is characterized by the infiltration of inflammatory cells into periodontal tissues. It has been shown that the increased inflammatory cytokines that occur in periodontal disease cause tissue destruction and have systemic effects. It is thought that the presence of periodontal inflammation in DM patients makes glycemic control more difficult. Chronic gram-negative periodontal infections may cause increased insulin resistance and poor glycemic control. Studies have shown that in periodontitis patients, serum inflammatory markers such as gram-negative organisms, CRP, IL-6, and fibrinogen are significantly higher. The systemic spread of these organisms or their products may trigger bacteremia or endotoxemia, a high inflammatory state, and an increase in serum inflammatory markers. Severe periodontal inflammation further increases circulating TNF-α concentrations by stimulating monocytes, which can have additional effects on insulin resistance by directly affecting target organs such as the liver, muscles, and adipocytes, and indirectly increasing the release of other insulin resistance molecules such as free fatty acids from adipocytes. In diabetic patients with severe periodontitis, the mortality rate due to ischemic heart disease was found to be higher than in diabetic patients without periodontitis or with mild periodontitis. When other known risks were taken into account, the mortality rate due to diabetic nephropathy was 8.5 times higher in DM patients with severe periodontitis. In a study evaluating over 600 patients with T2DM, it was demonstrated that the mortality rate due to cardio-renal disease was 3.5 times higher in patients with severe periodontitis.[17,21,22]

In a long-term case-control study, 82% of patients with DM and severe periodontitis and 21% of patients with DM and no periodontitis were found to have one or more major cardiovascular, peripheral vascular, and cerebrovascular events.[23]

PERIODONTAL HEALTH, GINGIVAL DISEASES AND CONDITIONS

Periodontal Health

Periodontal health is defined clinically as the absence of inflammatory periodontal disease. Periodontal disease includes both gingivitis and periodontitis. Gingivitis occurs as a result of the inflammatory response, which is the host's first defense mechanism against bacterial dental plaque that accumulates on the tooth surface. If this inflammatory response continues and is not treated, the lesion progresses to deeper tissues and causes loss of alveolar bone, which leads to periodontitis. Periodontitis is a disease that destroys the supporting structures of the teeth, including the periodontal ligament, bone, and soft tissues. Periodontal diseases, which are usually painless, are often noticed by the patient only in their late, irreversible stages.[14,16,24]

Classification of Periodontal Diseases

Periodontal diseases have been classified in many ways to date. The most recent classification was developed in 2017 by the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) following a meeting attended by experts. The classification includes the pathogenesis of periodontal conditions and diseases, their multifactorial etiology, the causes of the disease, and peri-implant diseases.[24]

According to the AAP and EFP, periodontal and peri-implant diseases and conditions were classified as follows in 2017 (**Table 1**).[24]

Periodontal Health, Gingival Diseases and Conditions

Gingivitis (induced by dental biofilm): Gingivitis is an inflammatory disease of the gums that occurs when the balance between bacteria colonizing the gingival sulcus and the host response is disrupted. Radiologically, bone loss is not observed in gingivitis. The clinical signs of gingivitis include changes in gum color, plaque on the gum line, increased DOS, bleeding on probing, changes in gum pocket temperature, changes in gum contour, and no attachment loss. Bleeding on probing and increased DOS are the earliest clinical signs of gingivitis. Gingivitis can be eliminated by removing plaque.[23-25]

Gingival diseases (not induced by dental biofilm): It covers a range of conditions that are not caused by bacterial dental plaque and therefore do not improve with plaque removal (Tonetti et al., 2018). Gingival diseases and conditions not induced by dental plaque/biofilm were classified as follows by the AAP and EFP in 2017.[23-26]

- Genetic/developmental disorders
- Specific infections
- Inflammatory and immune conditions
- Reactive processes
- Neoplasms
- Endocrine, nutritional, and metabolic diseases
- Traumatic lesions
- Gingival pigmentation

Table 1. Overview of periodontal diseases and conditions			
Periodontal diseases and conditions			
Periodontal health, gingival diseases and conditions	Periodontal and gingival health		
	Gingivitis (induced by dental biofilm)		
	Gingival diseases (not induced by dental biofilm)		
Periodontitis	Necrotizing periodontal diseases		
	Periodontitis		
	Periodontitis associated with systemic diseases		
Other conditions affecting the periodontium	Systemic diseases and conditions affecting periodontal support tissues		
	Periodontal abscesses and endodontic-periodontal lesions		
	Mucogingival deformities and conditions		
	Traumatic occlusal forces		
	Dental and prosthetic factors		
Peri-implant diseases and conditions			
Peri-implant health	Peri-implant mucositis	Peri-implantitis	Peri-implant soft and hard tissue deficiencies

PERIODONTITIS

Periodontitis is an inflammatory disease characterized by deep pockets and bone loss, associated with apical migration or attachment loss of the epithelium along the root surface due to microbial plaque accumulation. Periodontitis follows gingivitis and is also influenced by the host's immune and inflammatory response. Periodontitis is characterized by the destruction of the supporting structures of the teeth, including the periodontal ligament, bone, and soft tissues. In some cases, exposure of the root surface, gingival overgrowth or recession, furcation involvement, mobility, and the presence of pus may also be observed.[22-26] It has been demonstrated that preventing plaque accumulation through various professional and home-based techniques is highly effective in preventing attachment loss over a 15-year period.[27]

Periodontitis Stages

It can be categorized into four different groups in relation to the severity of the disease and the complexity of its treatment. In staging, factors such as loss of clinical attachment, tooth loss due to periodontal causes, percentage of bone loss, furcation involvement, angular defects are taken into consideration.[16,26]

Stage I periodontitis: There is a maximum of 1-2 mm interproximal clinical attachment loss. There is no tooth loss due to periodontal disease. There is less than 15% radiographic bone loss in the coronal triad. There is a pocket depth of 4 mm or less on probing.

Stage II periodontitis: There is a maximum of 3-4 mm interproximal clinical attachment loss. No tooth loss due to periodontal disease is observed. Radiographic bone loss in the coronal triad is between 15-33%. There is a pocket depth of 5 mm or less on probing.

Stage III periodontitis: Interproximal clinical attachment loss is 5 mm or more. Maximum tooth loss due to periodontal disease is 4 teeth. Radiographic bone loss extending to the middle or apical third of the root is observed. There is a pocket depth of 6 mm or more on probing. Deep intraosseous defects, furcation involvement, moderate crest defects and tooth loss make the treatment complex. Chewing function is preserved at this stage.

Stage IV periodontitis: Interproximal attachment loss is 5 mm or more. Radiographic bone loss extending to the middle or apical third of the root is observed. Class 2 or more mobility and masticatory dysfunction may be observed. There is loss of 5 or more teeth due to periodontitis and the number of remaining teeth is less than 20. Chewing function is impaired.

Degrees of Periodontitis

It grades the patient's individual susceptibility to periodontitis. Bone loss/age ratio is an important parameter used to determine the extent of the disease. C-reactive protein (CRP), HbA1c and smoking are risk factors that affect the rate of progression of the disease and may accelerate the transition to the next stage (**Table 2**).[26] Grading helps in diagnosis and treatment as it includes individual patient factors.[24-27]

PERIODONTAL PATHOGENESIS

More than 108 species have been isolated from 1 mm3 of dental plaque weighing approximately 1 mg. Approximately 800 different bacterial species have been identified in the oral cavity and 50-60 different species have been isolated from dental plaque samples. Pathogenic microorganisms in plaque and their products initiate the inflammatory response. As a result of the interaction between these etiologic agents in dental plaque and the host tissue response, destruction of periodontal tissues is observed. Microorganisms in dental plaque must have at least 3 characteristics in order to be pathogenic;[22-28]

- Colonization of periodontal tissues
- Overcome host antibacterial defense mechanisms
- Secreting substances that can cause tissue destruction

According to the histopathologic characteristics of these changes, 4 stages of periodontal disease progression have been defined as initial, early, established and advanced lesions.[22-28]

Initial Lesion

It can be defined as the physiologic response of clinically healthy gingiva without signs of inflammation to a small amount of microbial dental plaque. It occurs in the first 4 days following plaque accumulation and changes in the tissues

Table 2. Grades of periodontitis

Grades of periodontitis			Grade A: slow rate of progression	Grade B: moderate rate of progression	Grade C: rapid rate of progression
Primary criteria	Evidence of direct progression	Longitudinal data (radiographic bone loss or CAL)	No bone loss over 5 years	More than 5 years <2 mm	More than 5 years ≥2 mm
	Evidence of indirect progression	% bone loss/age	<0.25	0.25-1.0	>1.0
		Case phenotype	Low level of degradation relative to the amount of biofilm	Degradation proportional to biofilm	Greater degradation relative to the current biofilm: Specific clinical patterns suggestive of periods of rapid progression and/or early disease (e.g., molar/incisor pattern; lack of expected response to standard bacterial control therapies)
Degree modifiers	Risk factors	Smoking	Non-smoker	Smoker <10 cigarettes/day	Smoker ≥ 10 cigarettes/day
		Diabetes	Normoglycemic/no diagnosis of diabetes	HbA1c <7.0 % diabetes patient	HbA1c ≥7.0 % diabetes patient
Risk of systemic effects of periodontitis	Systemic load	High sensitivity CRP (hsCRP)	<1 mg/L	mg/L	>3 mg/L
Biomarkers	CAL/indicator of bone loss	Saliva, gingival crevicular fluid, serum	?	?	?

CAL: Clinical attachment loss, CRP: C-reactive protein, hsCRP: High sensitive CRP

are only visible histologically. There are increased spaces between endothelial cells, vasodilatation in the vasculature and high hydrostatic pressure in the microcirculation. These changes lead to increased vascular permeability and allow the migration of neutrophils and monocytes towards the bacterial products in the gingival sulcus causing a chemotactic effect. The increase in DOS helps to wash away bacteria and their products by dilution of the bacterial products.[26]

Early Lesion

It covers the period of 4-7 days following plaque accumulation and early clinical findings are observed. It develops as a result of the failure of the host immune response to eliminate the infection. The gingiva is erythematous as a result of vasodilatation. Increased vascular permeability increases the flow of DOS. There is an increase in macrophages, neutrophils, lymphocytes, mast cells and plasma cells in the connective tissue. 75% of these lymphocytes are T cells. Fibroblasts degenerate through apoptosis and collagen fibers begin to break down to provide space for leukocytes. Collagen tissue destruction is increased by 60-70% and retepegs are present in the junctional epithelium. There is redness and edema of the gingival tissues and bleeding on probing.[26-28]

Localized Lesion

It is the stage that occurs between 14-21 days following plaque accumulation, in which inflammation cannot be stopped and is called "chronic gingivitis". As inflammation continues, connective tissue destruction and bone tissue damage increase. Along with macrophages, T and B lymphocytes and plasma cells are dominant in this stage. Pocket drainage is impaired as a result of more apical migration of the junctional epithelium. With increased vascular permeability, inflammatory cytokines; inflammatory markers such as IL-1, TNF- α, PGE2 continue tissue destruction. While the inflammatory cell infiltrate settles in deep tissues, collagen destruction continues with collagenase activity. The junctional epithelium transforms into a pocket epithelium that allows the biofilm to migrate into deeper tissues. Bone destruction is not yet seen at this stage. Moderate inflammation is seen clinically in the gingiva.[26-28]

Progressed Lesion

It is the stage of transition from gingivitis to periodontitis in which destruction of periodontal tissues begins. Loss of attachment can be observed both histologically and clinically. Inflammatory cell infiltration with a predominance of plasma cells penetrates deeper tissues. Inflammatory cytokines (IL-1, PGE2 and TNF-α) stimulate fibroblasts to produce matrix metalloproteinase which causes extracellular matrix degradation. As the junctional epithelium migrates apically, collagen degradation increases. Attachment loss and bone loss become visible at this stage. Not all gingivitis lesions progress to periodontitis. The effects of bacteria on host tissue, host immune response, genetic and environmental factors play a role in the progression to periodontitis. The determining factor in bone loss is neutrophil count. Neutrophils are an important source of IL-17, an osteoclastic cytokine. They can induce inflammatory cells such as lymphocytes, polymorphonuclear leukocytes and macrophages. Lymphocytes can activate macrophages to synthesize and secrete a number of molecules such as IL-1 and TNF-α-like cytokines, proteolytic enzymes and PGE2. Lymphotoxin, a molecule similar to TNF-α and IL-1, is produced when bacterial agents activate T lymphocytes. These cytokines play a key role in periodontal tissue destruction. Metalloproteinase products cause extracellular tissue destruction. Both TNF-α and IL-1 production are suppressed by PGE2, exerting a control on the development of periodontal disease. Transforming growth factor-ß (TGF-ß)-like cytokines suppress matrix metalloproteinase production. The progression and extent of tissue destruction can be determined by the activity of molecules such as TNF-α, IL-1, PGE2 and TGF-ß.[26-30]

PERIODONTAL TREATMENT

The aim of periodontal treatments is to stop tissue destruction and disease progression by relieving inflammation in periodontal tissues. Initial periodontal treatment includes comprehensive teaching of plaque control, complete removal of calculus and bacterial dental plaque, treatment of existing decayed teeth and treatment of inappropriate restorations. Improvements in pocket depth, gingival index, clinical attachment level and bleeding on probing have been shown

after initial periodontal treatment. Periodontal treatment is divided into non-surgical and surgical treatment. Removal of microbial dental plaque accumulated in the supragingival and subgingival areas is the primary procedure for the removal of inflammation in periodontal tissues. Non-surgical periodontal treatment is a periodontal treatment that includes scaling and root surface smoothing. In non-surgical periodontal treatment, manual crettons and curettes or ultrasonic instruments or a combination thereof are used. Both types of instrumentation have similarly improved clinical parameters such as decreased pocket depth, decreased bleeding at probing and decreased clinical attachment loss. Non-surgical periodontal treatment of patients with advanced periodontitis with good oral hygiene has been shown to yield similar results when performed alone and in combination with the modified Widman flap. In a study comparing the mean of clinical measurements, no difference was observed between non-surgical and surgical treatments and non-surgical treatment was shown to be an effective treatment. Following nonsurgical periodontal treatment, clinical attachment gains and significant reduction in pocket depth were observed in areas with pocket depths of 4-6 mm and ≥7 mm.[3,13,16,26-32]

Lipotoxicity is a critical factor that not only aggravates the complications of diabetes, but also increases the severity and progression of diabetes-related periodontitis. Treatment approaches targeting this process are becoming increasingly important. Thanks to the lipotoxicity-reducing effects of agents such as metformin, statins, liraglutide, adiponectin and omega-3 fatty acids, it is thought that periodontal tissue damage can be reduced by controlling processes such as oxidative stress, inflammation and cell death. Accordingly, treatment strategies targeting lipid metabolism are promising in the management of diabetes-related periodontal diseases.[33]

He examined the effect of SIRT3 protein on the senescence and bone-forming ability of human periodontal ligament stem cells in diabetes-induced periodontitis. SIRT3 was shown to be suppressed under diabetic conditions, which accelerated cell senescence and inhibited bone regeneration. SIRT3 was also found to regulate this process by acetylating a protein called LRPPRC, and a compound called honokiol activated SIRT3 to delay aging and promote bone healing. The results revealed that SIRT3 may be a novel therapeutic target for diabetes-associated periodontitis (SIRT3 is a next generation biomolecular therapeutic agent that can be targeted to protect periodontal tissues and promote regeneration in diabetic conditions).[34]

It emphasizes that immune system imbalance plays a fundamental role in the development of diabetes-associated periodontitis (DPD). There is limited but promising evidence that some existing drugs (e.g. metformin, antibiotics, vitamin D) may provide potential benefit in the treatment of DPD by modulating the immune response. Therefore, drug therapies targeting the immune system are a promising approach for DPD.[35]

This study proposes hydrogel microneedle systems enriched with biologically active glass nanoparticles containing zinc and vanadium for the treatment of diabetic periodontitis. These microneedles exhibit antioxidant and antibacterial properties, providing direct drug delivery to gingival tissue and suppressing inflammation. Experiments in animal models have shown that this method enhances alveolar bone regeneration and suppresses inflammatory signaling pathways (JAK-STAT, NF-κB).[36]

This study revealed common genetic and immunological pathways between T2D and periodontitis, identifying the NCF1 and LRRC25 genes as new therapeutic targets for these two diseases. Furthermore, cellular function and metabolic pathways were shown to be altered depending on whether monocytes express these genes or not, thus biologically supporting the observed causal relationships.[37]

CONCLUSION

Diabetes is a systemic disease characterized by many major complications that determine the quality of life. Periodontitis is one of these complications. The metabolic disorders of patients with diabetes reduce the resistance of gingival tissues against infection, and the occurrence of gingival disease comes to the fore. The relationship between periodontitis and diabetes has been observed in many studies. The aim of this study is to provide information about diabetes and periodontitis, to explain the relationship between diabetes and periodontitis, and to provide the best possible dental care and counseling to the diabetic patient with general dental knowledge.

ETHICAL DECLARATIONS

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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