

Diabetes and periodontitis

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Abstract:

The main aim of this review is to update the reader with practical knowledge concerning the relationship between diabetes mellitus and periodontal diseases. Exclusive data is available on the association between these two chronic diseases till date. Articles published on this relationship often provide the knowledge of definitions of diabetes mellitus and periodontal diseases, prevalence, extent, severity of periodontal disease, complications of diabetes along with the possible underlying mechanisms. The authors reviewed human epidemiological studies, cross-sectional observations and longitudinal cohort, case control that evaluated variables exclusively over the past 30 years and the predominant findings from the "certain" articles are summarized in this review. This review clarifies certain queries such as 1) Do periodontal diseases have an effect on the metabolic control of diabetes? 2) Does diabetes act as a risk factor of periodontitis? 3) What are the possible underlying mechanisms relating the connection between these two chronic diseases? 4) What is the effect of periodontal intervention on metabolic control of diabetes? After a thorough survey of literature, it was observed that diabetes acts as a risk factor in development of periodontitis as periodontitis is significantly aggravated in patients suffering from diabetes having long term hyperglycemia. Different mechanisms underlying the association between the accelerated periodontal disease and diabetes are emerging but still more work is required. Major efforts are required to elucidate the impact of periodontal diseases on diabetes. At the same time, patients are needed to be made aware of regular periodontal maintenance schedule and oral hygiene.

Key words:

Diabetes, hyperglycemia, periodontal disease, risk factors

INTRODUCTION

Both diabetes mellitus and periodontitis are chronic diseases affecting large number of population worldwide. Changes in human behavior and lifestyle over the last century have resulted in a dramatic increase in the incidence of diabetes in the world. Diabetes mellitus is a group of metabolic disorders characterized by chronic hyperglycemia with disturbances of carbohydrates, fat and protein metabolism resulting from the defects in insulin secretion, insulin action or both.^[1] Periodontal diseases are a group of chronic, progressive bacterial infections resulting in inflammation and destruction of tooth supporting tissues.^[2]

Diabetes and periodontal disease are quantifying their association significantly in public health importance. The biological association between the two chronic diseases is extensively studied. The present review identified the research reports published on the relationship between diabetes and chronic periodontitis, since 1980.

EPIDEMIOLOGICAL CONSIDERATIONS

The prevalence of type 2 diabetes worldwide, which is increasing rapidly, represents a significant burden to human health because of its

numerous and often complications. As per WHO estimate, the number of incidence of adults with diabetes will rise from 171 million in 2000 to 366 million in the year 2030 over the world.^[1] Most predominantly, India is declared as the capital of diabetes because approximately 41 million Indians have diabetes till date and every fifth diabetic in world is an Indian.^[3] Hyperglycemia, polydipsia, polyuria, polyphagia, ketoacidosis are the characteristic symptoms of diabetes mellitus. The long-term effect may include development of nephropathy, neuropathy, retinopathy, cardiovascular, peripheral, vascular, and cerebrovascular disease.^[4,5]

Periodontal disease is a silent devastating condition and initially may not be taken as much seriously by the patient because early symptoms are less alarming. It is a group of inflammatory diseases that affect the periodontal attachment apparatus (cementum, a layer of calcified interfibrillar matrix and collagen fibrils on the root surface of the tooth).^[2] Out of this group of diseases, gingivitis and chronic periodontitis are most commonly seen clinically. According to one U.S. survey, 50% adults are affected by gingivitis, whereas chronic periodontitis is estimated to affect approximately 35% of the adult population where as moderate to advanced forms of the disease is estimated to affect 13% to 15% of adults.^[6]

Both the chronic diseases are more prevalent,

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more severe, and progress more rapidly when occurs concurrently. A plethora of epidemiologic studies have demonstrated that periodontitis is more prevalent and severe in type 1 and type 2 diabetes mellitus vs non-diabetics.^[7] In a large scale meta-analysis in which 3,500 adults are included, the association between non-insulin dependent diabetes mellitus and periodontal disease was examined. It reported a statistically significant relationship between diabetes and periodontitis. Tervonen and Knuuttila (1986) suggested a risk for periodontitis among diabetic patients. Furthermore, the risk is found to be related to the duration of diabetes and the degree of diabetic control.^[8] In a large epidemiological study in the U.S. (NHANES III), adults with poorly controlled diabetes had a 2.9-fold increased risk of having periodontitis compared to nondiabetic subjects; conversely, subjects with well-controlled diabetes had no significant increase in the risk for periodontitis.^[9] Similar risk has been confirmed in a separate longitudinal study of Gila River Indian population.^[10] In fact, one study showed that diabetic patients are 5 times more likely to be partially edentulous than nondiabetic controls.^[11] In another separate investigation, the risk of periodontitis is elevated by a factor 2.1 to 3.0 in diabetic patients.^[12] Multiple studies on the Pima Indian population in Arizona with very high prevalence of type 2 diabetes mellitus indicate the higher prevalence of periodontal disease in patients with insulin dependent diabetes mellitus.^[13] These findings are also reported in non-insulin dependent diabetic Turkish population.^[14] Firatli (1997) observed the similar results in a study of 44 type 1 diabetes children and adolescents and 20 healthy controls over 5 years.^[15] The relationship between diabetes and periodontal disease appears to be very strong within Aboriginal people.^[16,17] Several studies in separate ethnical groups have provided conclusive evidences that the prevalence, severity, and progression of periodontal disease are significantly increased in patients with diabetes.^[18-24]

Periodontitis is much more than a localized oral infection. The interrelationship between the periodontitis and diabetes suggests the predisposition of systemic disease to oral infection and vice versa. In order to understand the cellular/molecular mechanisms responsible for such a cyclical association, common changes associated with diabetes and periodontitis that produce a synergy when the conditions coexist are being studied.

Effect of periodontal disease on diabetes

Diabetic patients with periodontal disease may have increased risk of diabetic complications. In a separate analysis including over 600 subjects periodontal disease is suggested as a significant risk factor for myocardial infarction and stroke as well as diabetes. The patients with severe periodontitis have 2.3 times high death rate from ischemic heart disease as compared to rate in subjects with no or mild periodontitis. In the subjects with severe periodontitis, the death rate from diabetic nephropathy was 8.5 times higher subjects with no or mild periodontitis. The overall mortality rate from cardio renal disease was 3.5-fold higher in subjects with severe periodontitis, suggesting that the presence of periodontal disease poses a risk for cardiovascular and renal mortality.^[25] Other studies demonstrated that those patients with type 1 diabetes with periodontitis had a higher prevalence of ketoacidosis, retinopathy and neuropathy.^[26] A case controlled

study at baseline reported that diabetic patients with severe periodontitis have a greater prevalence of proteinuria, stroke, transient ischemic attack, attack, angina, myocardial infarction, and heart failure than in diabetic patients with mild periodontitis.^[27] These findings strongly suggest that with increasing diabetes-related complications, periodontal patients are more likely to develop additional long-term complications.

Effect of diabetes on periodontitis

Till date, influence of diabetes on oral health is extensively studied. Several studies revealed that the degree of glycemic control is an important variable in relationship between diabetes and periodontitis. A large scale analysis showed that individuals with type 1 diabetes manifested advanced periodontal diseases with a higher prevalence and severity of gingival inflammation and periodontal destruction being seen in those with a higher glycemic index. Significantly more periodontal attachment loss and alveolar bone was lost in type 1 diabetic patients who had poor glycemic control than those who were well controlled or non-diabetic patients.^[28] Similarly in a longitudinal study of 362 subjects, poorly controlled type 2 diabetic subjects showed an 11-fold increase in the risk for alveolar bone loss over a two year period compared to non diabetic control subjects.^[29] Tooth loss in Pima Indians with type 2 diabetes was reported to be 15 times higher than in those without diabetes.^[23] This finding has been confirmed in meta-analysis of studies in various diabetic populations.^[7] However, no significant risk of longitudinal bone loss has found in well controlled type 2 diabetic patients as compared to non-diabetic controls. Same phenomenon has been pointed out by other researchers.^[30-32] Significantly higher values of glycosylated hemoglobin, or HbA_{1c} are reported in children and adolescents with periodontitis.^[33-35]

Large number of investigations has provided the evidence that type 1 and type 2 diabetes increase the risk and severity of periodontitis, and vice versa periodontitis has been shown to have impact on diabetic status by using rodent studies although the underlying mechanism has not been discussed.^[36] The association between diabetes mellitus and periodontal disease is therefore, considered to be bidirectional: diabetes as a risk factor for periodontitis and periodontitis as a possible severity for diabetes. In fact, aggressive periodontitis is recognized as the sixth serious complication of diabetes.^[37]

Mechanism

Despite being extensive research, mechanism underlying the association of periodontitis and diabetes mellitus is not clear. However, while investigating the mechanism relating the link between these two chronic diseases, several studies have been focused on microbial flora of the dental plaque which is the primary etiologic agent of the periodontal disease. Anaerobic gram-negative pathogens *Actinobacillus actinomycetemcomitans*, *Bacteroides forsyntus*, *Porphyromonas gingivalis*^[38] and *Prevotella intermedia*, *Treponema denticola*, and *Eikenella corrodens*^[39,40] are found to be associated with development and progression of periodontal disease. Due to the accumulation of dental plaque, an inflammatory reaction occurs in the gingiva. In susceptible individuals, as the plaque matures, clinical attachment loss, gingival enlargement or recession, loss of alveolar bone, and periodontal pocket formation, or bleeding gums and if remain untreated ultimately results into tooth loss.^[41] In case of diabetic

provided the evidences that treatment for periodontitis in type 2 diabetic patients resulted in an improvement in glycemic control. Periodontal patients with diabetes mellitus receiving mechanical therapy, has shown marked reduction in glycosylated hemoglobin as compared to control group in the study using glycosylated hemoglobin as glycemic index.^[31] In a separate study in which 113 native Americans were provided ultrasonic scaling with systemic doxycycline, or irrigation with water, chlorhexidine, or povidone-iodine.^[69] The doxycycline-treated groups showed significantly great reduction in glycated hemoglobin, probing depth and subgingival microbial infection. Two way action of doxycycline, a modified tetracycline has been demonstrated; (i) its antimicrobial action and (ii) its ability to modify the host response. In another separate investigation, treatment group receiving full mouth scaling and root planning manifested statistically significant improvement in plaque index, gingival index, probing pocket depth, clinical attachment levels and bleeding on probing depth, and glycated hemoglobin as compared to the control group of patients without any periodontal therapy.^[70] One of the studies reported a 28 percent reduction in preterm low birth weight births in patients receiving scaling, root planing and a chlorhexidine mouth rinse or metronidazole when compared to that in the control group without treatment.^[71] D'Auito points out that insulin demand in type I diabetic patients decreases after periodontal treatment including scraping, radicular smoothing, curettage, local gingivectomies and selective extractions, scaling, and root planning in addition to the use of antibiotics such as penicillin and streptomycin.^[72] Hence, all these findings point towards the same direction: periodontal treatment in metabolically controlled type 2 diabetic patients resulted in a significant improvement in diabetic status and severity of its complications. Despite the generalized accepted fact that treatment of periodontal disease in diabetic patients may reduce the insulin requirements and improve the metabolic balance. However, till date no one has evaluated the effects of periodontal therapy on the metabolic state of the poorly-controlled diabetic patients.

Moreover, there appears to be no conclusive evidence suggesting strict metabolic control will improve periodontal status without periodontal treatment. However, a cause and effect relationship has not been established. Literature suggests that non-diabetic patients as well as diabetic patients with good metabolic control responds to periodontal therapy^[30,32,73], whereas poorly controlled patients show less significant improvement after periodontal therapy and manifest recurrence of periodontitis overlong term.^[74]

CONCLUSION

Periodontal disease and diabetes are strongly interrelated and have common pathobiology. Inflammatory events during periodontal disease may play an important role in development of diabetes and insulin resistance probably facilitates the progress of periodontal disease. Diabetes acts as a risk factor in development of periodontitis as periodontitis is significantly aggravated in patients suffering from diabetes having long term hyperglycemia. Different mechanisms underlying the association between the accelerated periodontal disease and diabetes are emerging but still more work is needed. Major efforts are required to elucidate the impact of periodontal

diseases on diabetes. At the same time, patients are needed to be made aware of regular periodontal maintenance schedule and oral hygiene.

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The screenshot shows a web browser window displaying a PubMed search results page. The search query is "Journal of Indian Society of Periodontology". The page shows two search results. The first result is titled "About the journal." and the second is "Application of ultrasound in periodontics: Part I." by Bains VK, Mohan R, Bains R. The page includes various UI elements like search filters, related data, and search details.

Search Results:

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- 2. **Application of ultrasound in periodontics: Part I.**
Bains VK, Mohan R, Bains R.
Senior Lecturer, Department of Periodontics, Saraswati Dental College and Hospital, Lucknow (UP), India.
Ultrasound is a branch of acoustics concerned with sound vibrations in frequency ranges above audible level. Ultrasound uses the transmission and reflection of acoustic energy. A pulse is propagated and its reflection is received, both by the transducer. For clinical purposes ultrasound is generated by transducers, which converts electrical energy into ultrasonic waves. This is usually achieved by magnetostriction or piezoelectricity. Primary effects of ultrasound are thermal, mechanical (cavitation and microstreaming), and chemical (sonochemicals). Knowledge of the basic and other secondary effects of ultrasound is essential for the development of techniques of application.
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