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Research Article

TYPE I DIABETES AS A PREDISPOSING FACTOR FOR ORAL DISEASES IN CHILDREN AND YOUNG ADOLESCENTS

¹Anandi Ganguli, ²Kavitha.M and ³Gargi S Murthy

Dayananda Sagar College of Dental sciences 50 feet Main Road, 1st stage Kumaraswamy layout,
Bengaluru, Karnataka 560078

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ABSTRACT

This review evaluates the influence of type 1 Diabetes on the oral health of children and adolescents. Type 1 diabetes mellitus (DM) is a chronic metabolic disorder with a rising incidence around the globe and manifesting typically in childhood. Several research studies have claimed an association between type 1 diabetes mellitus and oral problems in young patients. Type 1 Diabetes is found to be related to a multitude of oral complications such as tooth decay, dry mouth, tooth loss, higher plaque levels and a higher prevalence of gingival and periodontal irregularities. Conclusions on the relationship between type 1 DM and periodontal status have been drawn by many studies; some studies have indicated a correlation between the duration of diabetes and clinical attachment loss (CAL). Diabetic children were recorded to have a reduced salivary flow rate, with elevated levels of S. mutans, making them more prone to dental caries. Poor metabolic control also seemed to play a role in the manifestation of these symptoms; patients with poor glycaemic control exhibited more oral lesions and lower salivary flow rates as compared to those with well controlled diabetes. The results of many of the studies in this area are inconsistent and there is a need for further, more thorough research on this topic.

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INTRODUCTION

Diabetes mellitus is a group of disorders characterized by increased blood glucose levels. This elevation results from a deficiency in insulin secretion or increased cellular resistance to the action of insulin, leading to several metabolic abnormalities related to carbohydrates, fats and proteins. ^[1] Diabetes affects approximately 2-10 % of the population and more than 10 million people worldwide. ^[2-3] Type 1 diabetes is categorized as a systemic autoimmune disease marked by impaired insulin secretion from the pancreatic beta cells. It is involved in abnormal glucose and lipid metabolism regulation, causing hyperlipidemia and hyperglycemia ^[4]. This form of diabetes accounts for up to 5-10 diabetes cases and is usually predominant in adolescents and children. The lack of insulin production in these patients makes using exogenous insulin necessary to sustain life; hence it was previously called Insulin-dependent diabetes mellitus. ^[5-6] Diabetes. usually affects capillary-rich organs such as the kidneys, retina, and nerves, and microangiopathy-related complications. ^[7] Oral health complications commonly related to diabetes include xerostomia (dry mouth), dental caries, tooth loss, gingivitis, periodontitis, odontogenic abscesses, oral lesions like candidiasis and oral

lichen planus, burning sensation and soft tissue lesions of the mucosa and tongue. ^[8-9]

AIM OF THE REVIEW

This narrative review aimed to assess the effects of type 1 diabetes and its influencing factors on the oral health of children and young adolescents.

MATERIALS AND METHODS

The study was conducted using the following scientific databases: PubMed, Google Scholar, Embase and Scopus. Search terms used included type 1 Diabetes mellitus, children, dental caries, oral health, periodontal health, and tooth eruption. Thirty-five articles were selected from the digital search, and references of the selected articles concerned the association between type 1 diabetes mellitus and oral health in young patients.

DISCUSSION

Type 1 diabetes impact on the oral cavity is manifold. A series of studies explore the link between type 1 diabetes and oral health in children and adolescents. Several studies have demonstrated a correlation between type 1 diabetes and higher

*Corresponding author: Anandi Ganguli

Dayananda Sagar College of Dental sciences 50 feet Main Road, 1st stage Kumaraswamy layout, Bengaluru, Karnataka 560078

tooth decay rates, teething alterations, decreased salivary flow, xerostomia, gum and periodontal disease, and lesions, Soft tissue and impaired wound healing. All of these aspects of oral health and their relationship to type 1 diabetes as an underlying disease were then discussed in this article.

TOOTH ERUPTION

Teeth development in children with diabetes was found to increase rapidly until the age of 10, after which it gradually decreased. In addition, the edentulous period in the group of patients with type 1 diabetes lasted longer. It has also been determined that individuals with poor metabolic control had gingival inflammation associated with a higher rate of eruption [7]. Older children have delayed eruptions [10]. One study demonstrated that children with diabetes under the age of 11.5 years had no significant changes in tooth development, but older children exhibited a delay in development. [11] Another study observed that children with type 1 diabetes below the age of 11.5 years had a faster rate of eruption, while children above 11.5 years of age had a delayed eruption process [12].

DENTAL CARIES

Numerous studies have documented the prevalence of tooth decay in children with type 1 diabetes; however, there is some degree of inconsistency in the results. A meta-analysis found that almost 67% of children and young adolescents with type 1 diabetes had dental caries with a mean DMFT value of 5.7 [13]. It was found that people without diabetes had a lower rate of tooth decay than people with type 1 diabetes, and the number of cavities increased with age for both diabetics and healthy individuals. [7] This is consistent with the findings of [14], who stated that the DMFT index of children with type 1 diabetes was higher than that of children without diabetes. According to this study [14], the prevalence of component D (Decayed) was higher in diabetic patients as compared to controls, while component F (Filled) was higher in the non-diabetic group - type 1 diabetes. Dental caries is a multifactorial disease, and its predisposing factors include oral pathogenic bacteria, consumption of fermentable carbohydrates as substrates for caries-causing bacteria, and ample time permitted for caries to form. Levels of pathogenic bacteria, especially *Streptococcus mutans*, were higher in diabetics, and a higher proportion of individuals had greater levels of pathogenic bacteria, especially *Streptococcus mutans*, in the diabetic population. [15] Additionally, it has been reported that insulin deficiency can lead to deteriorating alterations in the salivary glands, leading to a reduction in the rate of salivary flow and salivary buffering capacity. [13] In another study, the author stated that decreased salivary flow due to hyperglycemia was a predominant feature of poor metabolic control in diabetic patients. [16] The glucose leakage into the oral cavity during this period can facilitate the growth of aciduric and acidogenic bacteria and the formation of carious lesions. Multiple studies have shown that children and adolescents with type 1 diabetes have a high uptake of saturated fat. Furthermore, consuming these high saturated fats, which are energy dense and low in nutrition, is linked with weight gain and obesity, leading to tooth decay in children. [17][18]. A higher rate of caries has been observed, especially in the root region of type 1 diabetics. However, some studies have shown a lower caries prevalence in diabetics as opposed to their healthy counterparts. A study showed that people with diabetes had lower caries prevalence than non-diabetic controls, who also had higher oral debris scores. [20] Even though earlier

studies have attributed lower caries prevalence to lower carbohydrate intake and insulin treatment regimens, this study confirmed that modern diabetes management, including less rigid meal plans and flexible use of insulin, diminishes the influence of diet on caries development. Whereas the role of good metabolic control in these diabetic patients is also a matter of significance [20]. In another study, the key finding was that diabetic children and adolescents with poor metabolic control had thrice more lesions during the study period than those with improved metabolic control. [21] The authors conclude that children and young adolescents with poorly controlled type 1 diabetes may develop rampant dental caries despite comprehensive preventive care, the main risk factors being lack of good oral hygiene, previous experience with caries and higher levels of lactobacilli in saliva.

Salivary Status

Many studies have reported qualitative and quantitative changes in diabetic saliva. Diabetic individuals often show a decreased salivary flow. One study mentioned that significantly lower levels of saliva were found in diabetic children. [14] A diminished salivary flow rate has also been recorded in diabetic children in some studies. [22][23] Type 1 DM is related to a higher incidence of xerostomia (53%) in adolescents [22], and mean salivary flow rates are reported to be low and hyposalivation more prevalent among diabetic patients. [8] As per another study [20], the mean flow rate of unstimulated saliva was 0.26 in diabetics and 0.34 in healthy controls, while the mean flow rate of stimulated saliva was 1.17 in diabetic patients and 1.49 in non-diabetic patients. The salivary pH and buffering capacity are also found to be lower in diabetics. In one study, the pH of saliva in the non-diabetic group displayed a mean of 7.071, and for the diabetic group, it was 6.406, which was significant statistically [24]. Glycosuria, caused by hyperglycemia resulting in dehydration and fluid loss, as well as salivary gland pathologies, might be the reasons behind improper saliva production. [14] Diabetics with poor glycaemic control have lesser rates of salivary flow than patients with well-controlled diabetes. [25] However, several studies have not recorded significant differences in salivary flow, pH, or buffering capacity between diabetics and non-diabetics. [26] Increased levels of *S. Mutans* and lactobacilli have been reported in patients with diabetes, and lactobacilli and *S. Mutans* are known indicators of the cariogenic environment. [21] Glucose, total sugars, total proteins and amylase were found to be more abundant in the saliva of diabetic patients. [23] This is similar to the finding of [14] that, due to decreased salivary flow, patients with diabetes may have increased concentrations of glucose and mucin and proliferation of pathogenic microorganisms. The results are inconsistent when it comes to calcium levels. A higher calcium level [27] and a lower calcium level [23] have been reported in the saliva of diabetic patients, as per different studies.

PERIODONTAL HEALTH

It is a well-known fact that there is a two-way relationship between periodontal health and diabetes. Several mechanisms have been proposed to illustrate the relationship between diabetes and periodontal status, which can be considered as changes in repair processes, vasculature, and cellular processes of the host. The two main risk factors for the occurrence of chronic complications of diabetes are the duration and severity of the hyperglycemia. [28] Type 1 diabetics reported higher

gingival and periodontal index values than controls.^[7] A positive relationship was found between the duration of diabetes and clinical disassociation (CAL), wherein observations showed that the longer the diabetes duration, the greater the prevalence and severity of periodontal disease^[2]. This finding has been supported by other studies.^[29]^[19] reported significantly higher mean periodontal exploration depth and clinical disintegration values in children with diabetes compared with non-diabetic controls^[2]. In another case-control study, children with type 1 diabetes had significantly higher plaque and gingival indices and more bleeding on exploration compared with control subjects; They also showed an association between periodontitis and prolonged duration of diabetes^[30]. In a 5-year study^[19], the rate of clinical disconnection (CAL) was remarkably higher in diabetic subjects, with a similar association between the duration of diabetes and CAL. However, in another 3-year longitudinal study [31], no differences in measured clinical parameters and subgingival microbiota were found between diabetic and non-diabetic subjects, although there was a decrease in gingivitis in the non-diabetic group with an improvement in SBI (Sulcus Bleeding Index). One study^[25] observed an increased incidence of gingivitis and plaque accumulation in diabetics and attributed these to an elevated inflammatory response to periodontal pathogens, diminished tissue repair and regeneration, and the effects of advanced glycation end products. They emphasized the role of personal oral hygiene practices and professional oral health care in the prevention of periodontal disease; An improvement in API and OHI was indeed observed in patients who underwent oral hygiene tuition.^[32]

TREATMENT CONSIDERATIONS

Diabetes Type 1 can be managed with insulin and changes in diet and exercise.^[33] Working alongside a physician and nutritionist, the dentist can help maintain the patient's oral health and boost their metabolic control. A dentist can use a glucometer to check the patient's blood sugar levels; if the levels are congruous with hyperglycaemia, then a prompt follow-up with the physician is advised; the dentist, therefore, plays an essential role in referring diabetic patients to physicians for evaluation. Diabetic patients should preferably be given short morning appointments to lower their stress. Type 1 diabetic patients are known to exhibit a higher incidence of dental caries and require daily oral care with regular dental visits; at the same time, the efficacy of the preventive programs should be reviewed. Before any surgical/invasive procedure, the patient's blood sugar should be tested to avoid any emergencies, including insulin shock or ketoacidosis with severe hyperglycaemia that can occur before, during or after the procedure. The treatment approach for xerostomia typically includes salivary substitutes and stimulants. Salivary stimulation or replacement therapy can be done to retain moisture in the mouth, which aids in the prevention of dental decay. The prevention of periodontal disease involves educating the patient about the importance of oral health along with the removal of plaque and calculus through self-care and professional help.^[7] Periodontal surgical procedures can be performed, taking into account the patient's history of complications and glycaemic control, and supportive periodontal therapy should be provided at regular intervals.^[34] Diabetic patients undergoing extensive periodontal and surgical procedures should also be given dietary instructions. The dental

team should focus on maintaining optimum oral health for diabetic patients, thereby improving their metabolic control. The dentist can also discuss with the physician, the indications and contraindications of medications to treat the oral complications resulting from diabetes and strive to provide better oral care for such patients.^[34]

CONCLUSION

Type 1 Diabetes is an endocrine, metabolic disorder of childhood and adolescence, the incidence of which has reportedly been increasing worldwide and has significant consequences on physical and emotional development.^[20] It is characterized by hyperglycaemia and dysregulation of protein and lipid metabolism, resulting in one or multiple complications in the eyes, blood vessels, heart, kidneys and nervous system.^[38] T1DM exhibits a range of oral symptoms, including tooth decay, reduced flow of saliva, periodontal diseases, and oral soft tissue lesions such as candidiasis, lichen planus, and geographic tongue, which have been documented in several studies. Metabolic control and duration of diabetes also play a role in manifesting these symptoms. The dentist, therefore, contributes to aiding the patient to maintain glycaemic control by treating oral diseases and guiding them to maintain proper oral hygiene and diet.^[34] Some contradictory studies report no significant changes in the oral health of patients with diabetes compared to their non-diabetic counterparts. Further studies are needed to justify the effects of type 1 diabetes on the oral health of children and young adolescents.

Future Prospects

Even though extensive research has been done in this area, there is substantial scope for a more rigorous investigation into the oral manifestations of Type 1 diabetes in children and its management. Burning mouth syndrome in diabetics, association between the duration of diabetes and periodontal health as well as the incidence of coronal and root caries in diabetic patients are some of the areas where subsequent research can be done.

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