Review Article

Significance of Diabetes (Siphon) in General And Orthodontic Treatment – A Literature Review

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ABSTRACT

Diabetes Mellitus is a metabolic disorder of carbohydrate, protein and fat resulting from defective synthesis of insulin or its action on body tissue. It is one of the most commonly affected diseases worldwide and India has increasing prevalence in 2018 from 45% to 64%. Some of the deleterious effects of diabetes on oral health include xerostomia, debris accumulation, dental caries, recurrent infections, periodontitis etc. Periodontal destruction is the limiting factor in the orthodontic treatment. Maintaining oral hygiene and prevention of periodontal destruction is important before seeking for orthodontic treatment. Many researches and advancements made for periodontally compromised patients which include low profile brackets, copper NiTi wires and additional anchorages like mini screws. This article emphasizes on significance of diabetes in general and in orthodontic patients and treatment modalities of such patients.

Keywords:-*Antibiotic prophylaxis, Diabetes mellitus, Low profile brackets, Orthodontic tooth movement, Siphon.*

Diabetes Mellitus is defined as a heterogenous metabolic disorder of chronic hyperglycemia with disturbance of carbohydrate, protein and fat due to absolute or relative deficiency of insulin secretion, insulin action or both. Diabetes is a Greek word that means SIPHON; it was named by Aretaeus of Cappadocia. He described it as a great flow of wonderfully sweet urine. Thomas Willis found the urine of diabetes as wondrous sweet, as if imbued with honey. Later, William Dobson realized that serum of diabetes patients was also sweet Cullen added the word mellitus which means honey [1,2]. The prevalence of Diabetes Mellitus is growing worldwide and increased to 64% in India [3].

The classical symptom of hyperglycemia is polyuria, polydipsia and polyphagia, blurring of vision. In severe cases results in ketoacidosis. Pathological and functional changes are appreciated in long term diabetes such as retinopathy, nephropathy, neuropathy etc. In addition, increased tendency for periodontal disease is often found. Periodontal disease is considered as sixth major complication of diabetes. Diabetes alters the response of periodontal tissues to local factors such as bacterial pathogens, polymorphonuclear leukocyte function and altered collagen metabolism.

CLASSIFICATION

The older system of classification divides diabetes into primary and secondary, juvenile- onset and maturity onset types and insulin dependent (IDDM) and non-insulin dependent (NIDDM) types. The etiological classification as per WHO designate the defects, disorder or processes which often result in diabetic mellitus [4]. TYPE 1: Insulin dependent Diabetes (beta cell destruction causes insulin deficiency)

    - Auto immune
    - Idiopathic
- TYPE 2: Non-insulin dependent Diabetes (insulin resistance due to relative insulin deficiency and secretory defect of insulin).
- OTHER SPECIFIC TYPES:
    - Genetic defects of cell function
    - Genetic defects of insulin action
    - Diseases of the exocrine pancreas
    - Endocrinopathies
    - Drug on chemical induced infections
    - Uncommon forms of immune medicated diabetes
    - Other genetic syndromes sometimes associated with diabetes
- GESTATIONAL DIABETES

ETIOLOGY

The etiology of diabetes mellitus is multifactorial – an interplay of genetic, epigenetic and environmental factors, primary destruction of islet cells, cancer, surgery and trauma. A complication of endocrine disorder such as anterior pituitary hyperfunction, acromegaly, cushings disease and pheochromocytoma. Iatrogenic after the administration of corticosteroids.

RISK FACTORS

- Type 1 Diabetes: Idiopathic cause
- Type 2 Diabetes: A number of factors that can increase a person's risk of developing disease.
    - Family history of diabetes
    - Overweight or obese
    - Inactive lifestyle
    - Race and ethnicity
    - Aboriginal or torres strait islander, Melanesian polynesion, Chinese, southeast asian, middle eastern or from Indian sub-continent
    - Gestational diabetes
    - Polycystic ovarian syndrome
    - History of vascular disease

PATHOGENESIS

Depending upon the etiology of Diabetes Mellitus, hyperglycemia may result from

- Reduced insulin secretion
- Decreased glucose use by the body
- Increased glucose production

Type 1 Diabetes mellitus is caused as a result of the synergistic effects of genetic, environmental, immunologic factors that ultimately destroy the pancreatic beta cells. Individuals with a genetic susceptibility have normal beta cells secondary to autoimmune destruction that occurs over months to year [5]. In Type 2 Diabetes mellitus, the cause is a combination of resistance to insulin action and an inadequate compensatory insulin secretor response. In this type of diabetes, the hyperglycaemic develops gradually and starts usually at the age of 40 or later [5,6].

Table 1: Pathophysiology of Dental Complications of Diabetes [7,8]

Mechanism	Pathophysiology and Impacts
Diabetic microangiopathy	Small and medium sized vessel angiopathy Decline blood flow to dental structure Ischemic tooth ache Tenderness of gum Bone erosion Teeth loss
Polymorphic dysfunction	Recurrent oral ulcers
Protein metabolism impairment	Collagen breakdown and delayed healing

EPIDEMIOLOGY OF DIABETES

Burden of Diabetes is substantially increasing among the age group of 20 years and 70 years at the estimated rate of 8.7%. Peak incidence of Type 2 DM is the fifth decade of life due to unhealthy diet, sedentary lifestyle and tobacco use. India is considered as one of the 6 countries of the IDF SEA region. 425 million people are suffering from diabetes in the world and 82 million people have diabetes in the SEA region; by 2045 this is thought to rise to about 151 million. These were over 72,946,400 cases of diabetes in India in 2017(Indian international diabetes federation)Prevalence of DM is growing rapidly worldwide and is reaching epidemic proportions. Due to lack of awareness in diabetic symptoms and risk factors people of low socio-economic status find difficult in managing diabetes [9].

AGE AND SEX DEPENDENT DIFFERENCES

Many studies from different countries reported to an increase of the incidence with increasing age. The highest

incidence was found in the 10-14-year-old group [10,11].Type 1 can be assumed to be the only major organ specific autoimmune disease not to show a strong female bias. The overall sex ratio is roughly equal in children diagnosed under the age of 15 years [12] however, after the age of puberty, males are more frequently affected than females [11].

ETHNIC DIFFERENCES

Many large studies of type I diabetes have provided evidence that the ethnic background is one of the most important risk factors for type I diabetes [10,13] The onset of the disease is then triggered ubiquitous environmental factors,in general,[14,15] susceptibility of type I diabetes is attributable to genes that link disease progression to distinct steps in immune activation, expansion and regulation [16].

One half of the genetic susceptibility for type I diabetes is explained by HLA(human leucocyte antigen)genes and second half of the genetic susceptibility for type I diabetes is caused by more than 50 Non HLA genetic polymorphisms, it becomes that environmental factors play a crucial role in the onset of the disease and its epidemiology[15].

EFFECT OF SEASON OF BIRTH ON THE INCIDENCE OF TYPE 1 DM:

Authors describing a relationship between season of birth and susceptibility for type 1 DM have attributed this to intrauterine infections, dietary intake of certain nutrients & possible toxic food components, short duration of breast feeding, early exposure to cow milk proteins and vitamin D deficiency [17].

HLA susceptibility genes to be in different proportion of patients either born in different seasons of the year or having manifested their disease in different historical periods overtime [18].

SIGNS AND SYMPTOMS

1. HYPERGLYCEMIA:
   - Blood sugar more than 180mg/dl
   - Increased thirst
   - Headache
   - Trouble concentrating
   - Blurred vision
   - Fatique (weak, tired feeling)
   - Weight loss
   - Frequent urination
2. HYPOGLYCEMIA:
   - Blood glucose level-<60mg/dl
   - Altered consciousness (lethargy and obtundation or personality changes)
   - Tachycardia
   - Tremor
   - Shakiness
   - Anxiety
   - Increased sweating

SYSTEMIC MANIFESTATION

- Atherosclerosis
- Diabetic microangiopathy
- Diabetic Retinopathy,
- Diabetic Nephropathy
- Microvascular disease
- Diabetic neuropathy

Peripheral vascular disease [19]

Table 2:Criteria for the diagnosis of diabetes [20]

Measurement	Diagnostic values	Characteristics
Glycosylated haemoglobin	≥ 6.5%	The test should be performed in a laboratory using the standardized method. It reflects average blood glucose levels over 2-3 months
Fasting plasma glucose level	≥126mg/dl (7.0mmol/l)	Fasting is no caloric intake for 8 hours
Post prandial plasma glucose (2 hours after caloric intake)	≥200mg/dl (11.1mmol/l)	The test should be performed as described by WHO, using a glucose load containing the equivalent of 75g anhydrous glucose dissolved in water
Random plasma glucose	≥200mg/dl (11.1mmol/l)	

ORAL AND DENTAL MANIFESTATIONS OF DIABETES MELLITUS:

It is estimated that up to 50% diabetic patients develop oral and dental manifestations of diabetes at least once in their life time [21,22].

- Mouth dryness & burning (xerostomia)

- Oral acetone smells in poorly controlled patients
- Brittle teeth
- Dental caries
- Recurrent oral infections eg: oral Candida
- Mouth ulcerations
- Altered taste sensations
- Diabetes destroys periodontium causing gingivitis and periodontitis which results in tooth mobility and malalignment [7,21,23].
- Periodontal diseases [24]

An individual with uncontrolled diabetes will have an increased risk of infection and abnormal healing time that will compromise the health of the oral cavity. Patient with diabetes mellitus are also said to exhibit poor gingival health and higher plaque index levels compared to non-diabetic patients [25,26].Patient with type I diabetes and retinopathy tend to exhibit more loss of periodontal attachment by 4^{th} and 5^{th} decades of life. Thus, good oral hygiene and regular dental checkups are extremely important for patients with type I diabetes [27,28]. Investigators have reported that diabetes associated with prolonged expression of small mRNA for TNF – alpha Cc12, RANKL, colony stimulating factor 1 which may lead to more persistent inflammation and tissue damage [29].

Erdogan et al reported a case report of a 43-year-old female with type I diabetes mellitus with a chronic oroantral fistula in the right second molar region. The patient had bony necrosis in the donor site following palatal rotational flap operation [30]. Delayed skeletal maturation and decreased cephalometric linear and angular parameters are common in patients with juvenile diabetes and it should be considered during planning of orthodontic treatment. Factors that may contribute to oral complications in diabetes include decreased PMN and leucocyte function and collagen metabolism. In addition, impaired neutrophil chemotaxis and macrophage functions add to impaired wound healing in diabetic patients [26,31-33]. Patients having xerostomia are more susceptible to caries because of reduced salivary flow. Patient with periodontal problems also are more prone to develop dental caries. Other factors responsible are increased levels of streptococcus mutans and poor metabolic control of diabetes [34,35].

Periodontal reactions to orthodontic forces were studied by Holtgrave and Donadh. They found a retarded osseous regeneration, a weakening of periodontal ligament and microangiopathies in the gingival area [36]. Halitosis is primarily caused by bacterial putrefaction and the generation of volatile sulphur compounds. 10% of halitosis sufferers have systemic causes include diabetes mellitus and carcinomas [37].

DIABETES AMONG PATIENTS SEEKING ORTHODONTIC TREATMENT:

Orthodontic treatment was more common to be performed among adolescents and young adults. Recent advances encouraged elder individuals to seek dental clinics for orthodontic interventions. This leads to the increased prevalence of patients presenting to dental clinics with associated medical morbidities especially diabetes mellitus. Many researchers have reported that about 5% of patients seeking medical advice at dental clinics are diabetics [38].

Tight control of diabetes is essential to decrease the dental complication of the disease. Similarly, periodontal treatment is fundamental for reduction of HbA1c levels in diabetic patients [39]. Good diabetic control is of crucial importance in orthodontic treatment. It is noteworthy controlling the poorly or uncontrolled diabetes before orthodontic treatment to improve blood glucose level. Good oral hygiene is a main concern regarding fixed appliances because the affinity for plaque retention leading to tooth decay and periodontal breakdown.

ORTHODONTIC CONSIDERATIONS IN DIABETEC PATIENTS:

After orthodontic treatment pronounced changes in the periodontium are appreciated so treatment should be planned accordingly for poorly controlled diabetic patients. Traditionally, orthodontic treatment was considered as treatment modality for healthy young people. As the emergence of recent advances, orthodontic treatment is not contradicted for patients with tight control of diabetes and they should be under observance.

FACTORS CONSIDERING BEFORE DECIDING ORTHODONTIC TREATMENT:

Diabetes causes erosion of gum bones so diabetic patients teeth often get misaligned and move to undesirable positions. Many researchers said that due to poor bone turnover rate in diabetic patients leads to misalignment and destruction of bone due to compromised immune system in diabetic patients, antibiotic prophylaxis is essential in

certain orthodontic treatment procedures. Braha et al conducted a study on mouse model declared that diabetes had major negative impact on alveolar bone remodelling, and that reversed of diabetes was associated with improved in bone health and reduction in inappropriate tooth movement [40].

- Ensure good oral hygiene and dental health [41]
- Tight control of diabetes
- Exclude periodontitis
- Monitor blood glucose before going into active orthodontic treatment.

Diabetes may also affect bone turnover resulting in diminished bone mineral density, osteopenia, osteoporosis [42]and an increased prevalence and severity of periodontal disease, altered bone remodelling in diabetes, one of which is diminished bone formation as a result of decreased osteoblastic activity or enhanced apoptosis of osteoblastic cells [43]. Chemokine, cytokines and bone remodelling regulators influence the recruitment and activity of osteoblasts and osteoclasts [44].

Mini implant retention is only by mechanical interlocking in alveolar bone rather than osseointegration. One of the success factors are bone quality or density. Mini screw placement for well controlled diabetics under antibiotic prophylaxis [45].

FACTORS TO BE CONSIDERED DURING ORTHODONTIC TREATMENT:

- Early morning appointments advised.
- Advised to maintain good oral hygiene.
- Plaque control require much efforts such as mechanical aids – tooth brush and interdental brushes, chemical adjuvants – chlorhexidine mouth washes.
- Advice low profile brackets, copper NiTi wires
- Apply light orthodontic forces
- Antibiotic prophylaxis: before orthodontic band placement, Separator placement & screw insertion
- Antibiotic prophylaxis is not needed in simple adjustment of appliances: simple replacement of appliances [42,43].

CONCLUSION

Diabetic mellitus is commonly encountered in patients seeking orthodontic treatment. Because diabetes exerts a considerable negative effect on bone remodelling, diabetic patient's teeth are very likely to be misaligned and to require dental correction. During orthodontic treatment, they should be careful not to overload the weakened tooth, to give prophylactic antibiotics when required and to be aware with early signs of hypoglycaemia. A clear description of the essential components to support the relative importance and to prevent the iatrogenic effects to the periodontium

Insulin therapy reversed the diabetic condition to the same level as that of normal subjects. Type I diabetes mellitus results in greater orthodontic tooth movement and increased osteoclast count as compared to normal subjects under optimum orthodontic force level. Even though well control diabetes mellitus is not a contraindication for orthodontic treatment, periodontal problems must be meticulously taken care of during orthodontic treatment as there is greater tendency for gingival inflammation, periodontal breakdown and candida infections especially in type I diabetes mellitus. There should be good interaction between physician and orthodontist so that if the glycemic control of the patient tends to worse, the orthodontist can refer the patient to their physician

Orthodontic treatment should be avoided in patients with uncontrolled or poorly controlled diabetes mellitus. Patient with good metabolic control, without local factors such as calculus and with good oral hygiene have a similar gingival status as healthy patient and thus can be treated orthodontically.

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