Review Article

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MANAGEMENTS ORTHODONTIC TREATMENT IN PATIENTS WITH DIABETES MELLITUS

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ABSTRACT:

Diabetes mellitus DM affects all age groups and its prevalence has been increasing because of lifestyle changes, increased life span, etc. In order to provide safe and effective oral medical care for patients with diabetes, proper understanding of the disease is necessary, along with familiarity of the oral manifestations. The goal of therapy is to promote oral health in patients with diabetes, to diagnose diabetes. The sooner the disease is diagnosed, the better the prognosis of the patient, since complications in the early stage of the disease are less severe and more readily treated. As a member of the health care team, the dental practitioner should have knowledge of oral manifestations of DM to recognize initial symptoms of the disease. Also when treating DM patients, the practitioner must understand the consequences of the controlled disease in relation to orthodontic treatment. This paper reviews the management of DM patient during orthodontic treatment.

Keywords: Diabetes mellitus, oral health, oral manifestations, orthodontics

INTRODUCTION:

Diabetes is a Greek word that means siphon; it was named and described by Aretaeus of Cappadocia. He described it as a great flow of wonderfully sweet urine. The cardinal symptoms of the disease such as polyuria, polyphagia, polydipsia and loss of weight were described by Celsus. The ancient noticed that ants were attracted by the sweetness of urine. Thomas Willis found the urine of diabetics as wondrous sweet, as if imbued with honey, and a century later William Dobson realized that the serum of diabetic patients was also sweet. Cullen added the word mellitus to the name diabetes which means honey'. More recently, diabetes mellitus is defined as a chronic, progressive metabolic disease characterized by hyperglycemia resulting from defects in insulin secretion, action or both. [1,2]

Diabetes mellitus is a complex, chronic disease. It is a condition characterised by an elevation of the level of glucose in the blood. Insulin, a hormone produced by the pancreas, controls the blood glucose level by regulating the production and storage of glucose. In diabetes there may

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be a decrease in the body's ability to respond to insulin or a decrease in the insulin produced by the pancreas which leads to abnormalities in the metabolism of carbohydrates, proteins and fats. The resulting hyperglycaemia may lead to acute metabolic complications including keto acidosis and in the long term contribute to chronic micro-vascular complications . Phipps et al define diabetes mellitus as a complex, chronic disorder characterised by disruption of normal carbohydrates, fat and protein metabolism and the development over time of micro-vascular and macro-vascular complications and neuropathies. [1,2,3]

There are four major classifications of diabetes mellitus, namely:

-Type I diabetes mellitus results primarily from destruction of the beta-cells in the islets of Langerhans of the pancreas. This condition often leads to absolute insulin deficiency. The cause may be idiopathic or due to a disturbance in the autoimmune process. The onset of the disease is often abrupt, and patients with this type of diabetes are more prone to ketoacidosis and wide fluctuations in plasma glucose levels. [1,2]

-Type II diabetes mellitus is due to a range from insulin resistance with relative insulin deficiency to a predominantly secretory defect accom-panied by insulin resistance. The onset is generally more gradual than for type 1, and this condition is often associated with obesity. In addition, the risk of type 2 diabetes increases with age and lack of physical activity, this form of diabetes is more prevalent among people with hypertension or dyslipidemia. Type 2 diabetes has a strong genetic component; individuals with type 2 diabetes constitute 90% of the diabetic population. However, the gestational diabetes mellitus (GDM) is glucose intolerance that begins during pregnancy. The children of mothers with GDM are at greater risk of experiencing obesity and diabetes as young adults; there is a greater risk to the mother of developing type 2 diabetes in the futures. [1,2]

-Other types (type III)

This is where diabetes mellitus is associated with other conditions, for example, pancreatic disease, hormonal disorders and drugs such as glucocorticoids and oestrogen-containing preparations. Depending on the ability of the pancreas to produce insulin, the patient may require oral agents. [1,2]

-Gestational diabetes mellitus

The onset of Gestational diabetes mellitus is during pregnancy, usually in the second or third trimester, as a result of hormones secreted by the placenta, which inhibit the action of insulin. It occurs in about 2-5% of all pregnancies. About 30-40% of patients with Gestational diabetes mellitus will develop type II diabetes within 5-10 years . Impaired glucose tolerance and statistical risk groups are examples of

Gestational diabetes mellitus. Statistical risk groups are individuals at greater risk than the general population of developing diabetes, and the risk factors include immediate family members with the disease and presence of islet cell, antibodies. [1,2,3,4]

Type I diabetes mellitus affects people at a very young age, hence is also known as juvenile diabetes. The defect lies in the insulin producing beta cells of the islets of Langerhans in the pancreas, as they undergo autoimmune destruction. This results in lack of insulin secretion, leading to the disease. [5,6]

Type II diabetes mellitus affects adults. It is primarily caused due to lifestyle factors and genetics. It results from insulin resistance. Insulin secretion may also reduce with age, thus leading to the onset of diabetes. Gestational diabetes mellitus is similar to type II diabetes mellitus in that, there‟s a combination of relatively insufficient insulin secretion and responsiveness. It occurs in about 2-10% of pregnancies and may improve or disappear after delivery. [2,7]

Diabetes mellitus affects more than 140 million people worldwide and presently considered as one of the most frequent chronic disease. [2] Diabetes mellitus is increasing world-wide at an alarming rate with a global prevalence of 4% in 1995 and an expected rise to 5.4% by the year 2025, representing an estimated 300 million affected indi-viduals, compared with 135 million in 1993. Some other reports indicate that this rate is expected to be rise at 9% by the year 2025. Although diabetes has a worldwide distribution, it is seen more commonly in the developed European countries, US and Middle-East countries.[5] Recent estimates suggest that more than 100,000, inhabitants in the Middle-East suffer from type I diabetes and 6000 individuals in the region develop the disease each years. [1,3,5]

The most common effect of diabetes mellitus is delayed healing and an increased tendency for periodontal disease. Since orthodontic treatment involves inflammatory histo –pathologic changes around the tooth .There might arise an untoward reaction even to the normal orthodontic forces in diabetics. The orthodontist must be aware of the implications of this chronic metabolic disorder. [7,8,9,10]

Diabetes mellitus is characterized by increased levels of blood sugar levels.

Hyperglycemia causes delayed healing as a side effect. Orthodontic treatment

involves tooth movement which is brought about by the iatrogenic forces applied by orthodontists and an inflammatory reaction in response to these forces .The diabetic patient might not experience a physiologic healing process as a normal patient and might end up in an inadvertent break down of the supporting dental apparatus i.e. the periodontal ligament. DM is diagnosed based on the blood glucose concentration

of or Glycosylated hemoglobin concentration. [7,8,9,11,12]

This review aims at understanding the consequences of disease in relation to orthodontic treatment.

Oral Manifestations of Diabetes Mellitus

Oral manifestations associated with diabetes are in most cases restricted to the uncontrolled or poorly controlled patient. Factors that may contribute to oral complications in diabetes include decreased polymorphonuclear (PMN) leukocyte function and abnormal collagen metabolism. PMN dysfunction leads to impaired resistance to infections. Altered protein metabolism resulting from impaired utilization of glucose can contribute to increased breakdown of collagen in the connective tissues. In addition, impaired neutrophil chemotaxis and macrophage function may add to the impaired wound healing responses in diabetic patients.

The susceptibility to periodontal disease—often called the "**sixth complication of diabetes mellitus**"—is the most common oral complication of diabetes. The patients with uncontrolled diabetes are at an increasing risk of developing periodontal disease and show a tendency towards higher gingivitis scores. Patients with type 1 diabetes and retinopathy tend to exhibit more loss of periodontal attachment by the fourth and fifth decades of life. Thus, good oral hygiene and regular dental check-ups are extremely important for patients with type 1 diabetes. [12,13]

Diminished salivary flow is a common oral feature of DM, sometimes causing symptoms of xerostomia like burning mouth or tongue and dry oral mucosa. Occasionally, enlargement of the parotid salivary gland can be noticed. The

occurrence of decreased salivary flow may contribute to an increase in caries susceptibility. Also, increased exposure to bacteria, as a consequence of elevated salivary glucose levels, noticed mainly in poorly controlled or uncontrolled patients with DM, results in increased bacterial substrate and altered plaque microflora, favoring caries and periodontal disease. As a consequence, an increased incidence of dental caries has been reported among uncontrolled or poorly controlled patients with DM and, conversely, well-maintained patients with DM with good oral health measures show a reduced incidence of dental caries. This is due to dietary restrictions, effective metabolic control, and effective oral hygiene measures in combination with dental recall appointment schedules. [7,11,12,13,14,15]

Patients with well-controlled diabetes without local factors such as subgingival calculus have a periodontium comparable with nondiabetics. [14] Several studies show that gingivitis is more severe in children with diabetes and increases in severity with increasing blood glucose levels.[13,14] Even in well controlled diabetics there is more

gingival inflammation, probably due to the impaired neutrophil function. Vascular changes, such as diabetes-related microangiopathies, are responsible for complications in many organs such as the retina(retinopathy) and the kidney (nephropathy). Vascular changes also seem to favor progression of periodontal disease. [15] This was also confirmed by Rylander and colleagues, who compared the periodontal condition of 46 insulin-controlled young diabetics with healthy young adults. They reported significantly more gingival inflammation in those young diabetics with retinopathy and nephropathy compared with diabetics with no complications such as retinopathy and nephropathy. [7,9,12,16]

As periodontal disease tends to be more common and more extensive in patients with uncontrolled or poorly controlled diabetes, one could hypothesize that normalizing blood glucose levels should stop the progression of periodontal disease. This is, however, not true, since Sastrowijoto and colleagues demonstrated that an improved metabolic control in diabetes type 1 patients did not improve the clinical periodontal condition. The periodontal condition only ameliorates when local oral hygiene measures are intensified. One must realize, however, that the periodontal condition will continue to deteriorate when the blood glucose level is not well controlled. [17]

Periodontal diseases are bacterial infections and lesions affecting the tissues that form the attachment apparatus of a tooth or teeth and can result in the destruction of tissues supporting the teeth. It has been also demonstrated that periodontal disease is a micro-vascular complication of diabetes mellitus. Bi-directional relationship between diabetes and periodontal diseases can stimulate the chronic release of pro-inflammatory cytokines that have a deleterious effect on periodontal tissues. The chronic systemic elevation of pro-inflammatory cytokines caused by periodontitis may even predispose individuals to the development of type 2 diabetes mellitus". An indi-vidual with uncontrolled diabetes will have an in-creased risk of infection and abnormal healing time that will compromise the health of the oral cavity" . Patients with diabetes mellitus are also said to exhibit poor gingival health and higher plaque index levels compared to non diabetics. One of the following periodontal conditions may be associated with diabetes mellitus. [18,19]

Necrotizing periodontal disease is infection characterized by necro-sis of gingival tissues, periodontal ligament and alveolar bone. These lesions are most commonly observed in individuals with systemic conditions including, but not limited to HIV infection, malnutrition and immuno-suppression.[13]

Aggressive periodontitis occurs in patients who are clinically healthy, the common features include rapid

attachment loss, bone destruction and familial aggregation.

Chronic periodontal disease is resulting in inflammation within the supporting tissues of the teeth, progressive attachment and bone loss and is characterized by pocket formation and/or recession of the gingiva. It is recognized as the most frequently occurring form of periodontitis and is preva-lent in adults at any age. Progression of attachment loss usually occurs slowly, but periods of rapid progression may also occur. [17,18,19,20]

Erdogan et al reported a case report of a 43-year-old female with type I diabetes mellitus with a chronic oro-antral fistula in the right second molar region. The patient had bony necrosis in the donor site following palatal rotational flap operation. [20]

Lichen planus is a common, chronic mucocutaneous disease of with unknown etiology which is due to an immunologically mediated process that involves a hypersensitivity reaction on the microscopic level characterized by an intense T lymphocytic infiltrate located at the epithelial–connective tissue interface. Other immune-regulating cells such as macrophages, dendritic cells, Langerhans' cells are seen in increased numbers in lesions of lichen planus. No relationship between lichen planus and either hypertension or diabetes mellitus (Grinspan's syndrome) has been found. Improvement in glycemic control has a major role in reducing the occurrence of complications such as xerostomia and candidiasis. [14,21]

Oral candidiasis is an opportunistic fungal infection commonly associated with hyperglycemia and is a frequent complication of uncontrolled diabetes. Oral lesions associated with candidiasis include median rhomboid glossitis atrophic glossitis, angular cheilitis, denture stomatitis and pseudomembraneous candidiasis (thrush). Candida albicans is a constituent of the normal oral microflora that rarely infects the oral mucosa without the underlying causative factors which include immunologically compromised conditions, the wearing of dentures without maintaining proper oral hygiene and the long-term use of broad-spectrum antibiotics. [7,9,11,12,14]

Representative examples of acute oral infections—such as recurrent bouts of herpes simplex virus, a periodontal abscess or a palatal ulcer—represent the severity of these conditions, particularly in uncontrolled diabetes. It is possible that the same pathogenic mechanisms associated with the increased susceptibility to periodontal infections (for example, impaired wound healing, diminished chemotaxis and PMN function) may play a role in the greater likelihood of developing acute oral infections. Glycemic control in diabetes management is the key to reducing the impact of acute oral infections. [21]

Halitosis is primarily caused by bacterial putrefaction and the generation of

volatile sulfur com-pounds. Ninety percent of patients suffering from halitosis have oral causes such as poor oral hygiene, periodontal disease, tongue coat, food impaction, un-clean dentures, faulty restorations, oral carcinomas and throat infections. The remaining 10 percent of halitosis sufferers have systemic causes that include renal or hepatic failure, carcinomas, and diabetes mellitus . [14,16]

It could be said that dental caries occurs as a sequelae to other oral manifestations in diabetics. Patients having complaints of xerostomia are more susceptible to caries because of reduced salivary flow. Patients with periodontal problems also are more prone to develop caries. Other factors responsible are increased levels of streptococcus mutans and poor metabolic control of diabetes. [7,9,11,12,13]

Usually most of the diabetic patients are given dental treatments on an out-patient basis. More controlled medical environments are considered for giving treatments to patients with very poor glycemic control, severe head and neck infections, other systemic diseases or complications and to those who require long-term alteration of medication regimens or diet. It is preferable to give antibiotic coverage to diabetics prior to surgical treatments. Prophylactic antibiotic coverage is mandatory in emergency situations, especially in patients with poor glycemic control, but elective procedures are generally deferred until glycemic control improves. In those patients who have undergone extraction, it is advisable to place sutures over the empty socket in order to prevent the occurrence of the most common complication – dry socket. Patients should be kept on regular follow-ups to monitor the appearance and progress of new and already present dental decay, periodontal disease and for maintenance of oral hygiene and health. [10,11,13]

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Orthodontic Treatment Considerations

First and of the foremost importance to successfully treat a diabetic patient orthodontically is to have a good medical control. Patients with uncontrolled diabetes should not be considered for the treatment. If the patient is not in good metabolic

control (HbA 1c>90%) every effort should be made to improve blood glucose levels before starting the treatment. [3,4,7,9]

In patients with good medical control, all orthodontic/dental procedures can be performed without special precautions specially if there are no complications of DM. Both removable or fixed appliances can be used. When fixed appliances are used it is important to stress on good oral hygiene. [10,14,17]

The orthodontist should be aware of the significance of diabetes in relation to susceptibility to periodontitis. 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 complication in diabetes include decreased polymorphonuclear (PMN) and leukocyte function and collagen metabolism. In addition, impaired neutrophil chemotaxis and macrophage functions add to impaired wound healing in diabetes patients. [11,14,17,19]

Hypoglycemic reactions may thus occur more often in these patients. Diabetes type 1 is more often encountered in younger patients who will be more frequently selected for orthodontic treatment. Morning appointments are preferable. If a patient is scheduled for a long treatment session, that is, longer than 1½ hours, the patient should be advised to eat their usual meal and take their medication as usual. Before the dental procedure starts, the dental team should check whether the patient has fulfilled these recommendations or not. In this way a hypoglycemic reaction in the office can readily be avoided. [7,9,11,14,17,19]

Periodontal reactions to orthodontic forces were studied by Holtgrave and Donath. They found a retarded osseous regeneration, a weakening of the periodontal ligament, and microangiopathies in the gingival area. The authors concluded that the specific diabetic changes in the periodontium are more pronounced following orthodontic tooth movement. [22]

Since diabetes patients and, more specifically, uncontrolled or poorly controlled diabetic patients have an increased tendency for periodontal breakdown, these patients should be considered in the orthodontic treatment plan, as periodontal patients and treatment considerations must acaccordingly be made. Especially in adults, it is important before the start of the orthodontic treatment to obtain a full mouth periodontal examination including probing, plaque and gingivitis score, and to evaluate the necessity for periodontal treatment. First, the periodontal condition must be improved before any orthodontic treatment can take place. [13] During orthodontic treatment the orthodontist should monitor the periodontal condition of patients with diabetes and keep control

over the inflammation. As with all orthodontic patients, maintaining strict oral hygiene is very important. If plaque control is difficult to achieve with mechanical aids such as toothbrush and interdental brush, the use of a disinfectant mouth rinse of the chlorhexidine type, as an adjuvant chemical plaque control, can be considered. To minimize the neutralizing effect of the toothpaste on the chlorhexidine molecule, there should be at least a 30-minute interval between toothbrushing and a chlorhexidine rinse.[23] Chlorhexidine is cationic and forms salts of low solubility with anions, resulting in a reduced antimicrobial effect. Sodium lauryl sulfate, which is widely used as a detergent in toothpaste, is anionic.

Because today there is no upper age limit for orthodontic treatment, the practitioner will see both type 1 and type 2 DM patients. Type 2 patients can be considered more stable than type 1 patients, who can be presumed to be "brittle": strict compliance with the medical regimen is of the utmost importance to maintain control of blood glucose levels. Deviations from appropriate diet and the schedule of insulin injections will result in distinct changes in the serum glucose level. [13,23] Hypoglycemic reactions might occur more often in these patients. Type 1 DM is more often encountered in younger patients who frequently come for orthodontic treatment. [13,23]

In summary Orthodontic considerations:

a.Early appointments, preferably after breakfast or insulin dose, should be given to avoid hypoglycemia.

b. Xerostomia is seen is many diabetic patients. Daily rinses with fluoride mouthwash can provide urther benefits.

c. Check for HbA1c or contact the patient's physician to verify the control of the disease.

d. Periodontal condition should be evaluated before initiating the treatment and should be monitored in every visit and the patient should maintain good oral hygiene as they are prone for gingival inflammation due to impaired neutrophil function.

e. Only light orthodontic forces should be applied. Vitality of the teeth involved should be checked on a regular basis.

f. Periodontal condition should be evaluated before initiating the treatment and should be monitored in every visit and the patient should maintain good oral hygiene as they are prone for gingival inflammation due to impaired neutrophil function.

g. The orthodontist should be aware of the significance of diabetes in relation to

susceptibility to periodontal breakdown and orthodontic treatment should be

avoided in patients with poorly controlled Insulin-dependent DM.

h.Diabetes related microangiopathy can occasionally occur in the periapical vascular supply resulting in unexplained odontalgia, percussion sensitivity, pulpitis or even loss of vitality. Hence periodical checkups are advised[12].Check for HbA1c or contact the patient's physician to verify the control of the disease. [12]

Diabetes may also affect bone turnover, resulting in diminished bone-mineral density, osteopenia, osteoporosis, [16] and an increased prevalence and severity of periodontal disease Several mechanisms have been reported to explain the altered bone remodeling in diabetes, one of which is diminished bone formation as a result of decreased osteoblastic activity or enhancedapoptosis of osteoblastic cells. [17]

Another contributing factor may be increased bone resorptive activity. [17] However, it is still controversial whether osteoclastic recruitment and function are altered in diabetes, because no change or decrease in the activity of osteoclasts has been reported. Chemokine, cytokines, and bone-remodeling regulators [19] influence the recruitment and activity of osteoclasts and osteoblasts. Recent reports demonstrated increased expression of messenger ribonucleic acid (mRNA) for Ccl2, Ccl5, tumor necrosis factor-alpha (TNF-alpha), and receptor activator of nuclear factor-kB ligand (Rankl) that are associated with osteoclast recruitment and activity during orthodontic movement. [20] Previous investigators have reported that diabetes is associated with prolonged expression of mRNA for TNF-alpha, Ccl2,[21] Rankl, and colony-stimulating factor 1, which may lead to more persistent infl ammation and tissue damage. [21] However, the cellular and molecular mechanisms associated with the diabetic state that may influence orthodontic movement are not known.

The mini-implant retention results from the mechanical interlocking of its metal structure in cortical and dense bone and is not based on the concept of osseointegration. One of the key success factors are bone quality and/or density. [24]

Well-controlled diabetic patients can undergo mini-screw placement under antibiotic prophylaxis. [24]

Orthodontic bands placement and separator placement may produce significant bacteremia where significant oral bleeding and/or exposure to potentially contaminated tissue is anticipated, and this would typically require antibiotic prophylaxis in patients at risk. Simple adjustment of orthodontic appliances, do not require antibiotic prophylaxis. [22,23]

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periodontium are more pronounced following orthodontic tooth movement. Since diabetes patients and, more specifically, uncontrolled or poorly controlled diabetic patients have an increased tendency for periodontal breakdown, these patients should be considered in the orthodontic treatment plan, as periodontal patients and treatment considerations must accordingly be made. Especially in adults, it is important before the start of the orthodontic treatment to obtain a full mouth periodontal examination including probing, plaque and gingivitis score, and to evaluate the necessity for periodontal

treatment. First, the periodontal condition must be improved before any orthodontic treatment can take place. During orthodontic treatment the orthodontist should monitor the periodontal condition of patients with diabetes and keep control over the inflammation. As with all orthodontic patients, maintaining strict oral hygiene is very important. [25,26,27,28]

CONCLUSION:

The orthodontist should be aware of the significance of diabetes in relation to susceptibility to periodontitis. Orthodontic consideration includes delaying

orthodontic treatment when diabetes is poorly controlled. Periodontal health should be monitored during treatment and proper oral hygiene instruction should be given and appointments should be at the morning following insulin injection and breakfast. 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.

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