

Oral Health Care Guidelines for Patients with Diabetes Mellitus: A Review

Prasanna Kumar Rao¹, Dharnappa Poojary², Shailesh Kudva³, Ashok Kumar Jeppu⁴,
Kavitha Ashok Kumar⁵, Alok Dubey⁶

¹Professor, Oral Medicine & Radiology, A.J Institute of Dental Sciences, Kuntikana, Mangaluru 575004, Karnataka, India, ²Associate Professor, Oral and Maxillofacial Surgery, MCOODS Mangalore, Manipal Academy of Higher Education [MAHE], Light house hill road, Mangalore, ³Professor and Head, Oral Pathology, Srinivas Institute of Dental Sciences Mangalore, ⁴Discipline Lead, Biochemistry Unit, International Medical School, Management and Science University, Section 13, Shah Alam, 40100, Selangor, Malaysia, ⁵Discipline Lead, Otorhinolaryngology Unit, International Medical School, Management and Science University, Section 13, Shah Alam, 40100, Selangor, Malaysia, ⁶Associate Professor, Division of Pedodontics, Department of Preventive Dental Sciences, Jazan University, KSA

Abstract

Diabetes Mellitus [DM] is a metabolic disorder characterised by relative or obsolete insufficiency of insulin and resultant disturbances of carbohydrate metabolism. People with poorly controlled DM are at greater risk for dental problems. They are more likely to affect with oral infections. High and low blood sugar may also be able to cause many oral manifestations and some emergency situations in dental office. This article highlights on oral manifestations and dental considerations while treating these DM patients.

Keywords: Diabetic, oral infection, hypoglycaemia, hyperglycemia

Introduction

Diabetes Mellitus [DM] is one of the common medical problems affecting the general population. It is a metabolic disease characterized by dysregulation of carbohydrate, protein and lipid metabolism. There is no definitive cure for DM and it is most common endocrine disorder. The prevalence of DM is increasing steadily. It is one of the frequent pathologies that dentists encounter due to its high prevalence worldwide. ¹ So Dentists play a major role in providing oral care to patients with DM. ²

They may detect undiagnosed cases of DM and refer these patients to physicians for further evaluation.

CLASSIFICATION AND PATHOGENESIS OF DM:

DM may be the result of multiple reasons. Genetic type of DM is the most common type. This type is also called as Primary, hereditary or essential DM. ³ Blood glucose level in normal person will be within the range of 60 to 150 milligram per decilitre (mg/dL). In patients diagnosed as DM, these levels will be increased [Table 1].

Corresponding Author:

Dr. Dharnappa Poojary

Associate Professor, Oral and Maxillofacial Surgery

MCOODS Mangalore, Light House Hill Road

Mangalore 575001, Karnataka, India

Mob: 9901725285

Email: dharnappa.poojary@manipal.edu

TABLE 1: Blood Glucose level in DM

TEST	DM	NORMAL VALUE
Fasting	Equal or More than 126mg/dL	70 – 110 mg/dL
Post Prandial (2hrs after food)	More than 200mg/dL	140mg/dL
Random Blood Glucose	More than 200mg/dL	Below 200mg/dL

Insulin synthesized in beta cells of pancreas and secreted in to the blood in response to increased blood sugar level. Insulin plays an important role in the regulation of blood glucose. It promoting uptake of glucose from the blood in to cells and by its storage in the liver glycogen. It also helps in the uptake of fatty acids and amino acids as well as their conversion in to triglyceride protein stores. A lack of insulin or insulin resistance results in an inability of insulin dependant cells to use blood glucose as an energy source.⁴

GLYCOSYLATED HAEMOGLOGIN (HbA1c):

Longer-term diabetes control is carried out by monitoring the level of glycosylated haemoglobin. Haemoglobin is a protein attached to the red blood cells. Its main function is the transportation of oxygen around the body. When the haemoglobin molecule is surrounded by a high glucose level within the bloodstream then some of the glucose will become attached to the haemoglobin. This is called glycosylation. This haemoglobin will remain glycosylated until the red blood cell to which it is attached dies (approximately three months). The HbA1c is the ratio of glycosylated haemoglobin to unglycosylated haemoglobin given as a percentage.⁵ This level approximates to the average blood sugar level within the last three months. The Glycosylated Haemoglobin values are 4% to 5.7% (Normal), 5.7 % to 6.4% (Prediabetic), Morethan 6.5% (Controlled DM) & Above 7.5% (Uncontrolled DM).

Based on the pathogenic process there are four types of DM are identified. ⁶

- Type 1 DM →Insulin dependant DM, Which constitutes 5% to 10%

- Type 2 DM → Non Insulin Dependant DM, Which constitutes 90 % to 95%

- Type 3 or Secondary DM→ Due to other metabolic disorders/ Genetic defects of cell functioning of pancreas /Genetic defects of insulin action/ Any diseases of pancreas/ Endocrinal disorders/ Drugs/ Surgery

- Gestational DM → During Pregnancy

In Type 1DM, environmental factors such as viral infection and autoimmune reactions are the major causative factors. There is absolute insulin deficiency due to these factors which causes destruction or disappearance of insulin producing pancreatic beta cells.⁷This Type can occur at any age but more in childhood and adolescence. It leads to absolute insulin deficiency. Also these patients have high risks of severe complications.⁴ Type 1 DM is also prone to autoimmune disorders such as Graves Disease, Hashimoto’s Thyroiditis and Addison’s Disease. ⁴

Type 2 DM is complicated because patient present with varying degree of insulin dependency and insulin resistance.⁷strong Genetic role is more in Type 2 DM.⁸ This type of DM is results from impaired insulin function. The risk of this type DM is increases with Age, obesity and lack of physical activity.⁹

Type 3 or secondary DM are relatively uncommon. This type of DM is due to genetic defects of beta cell function or insulin action, diseases of pancreas, endocrinopathies, use of drugs, infections and certain genetic syndromes. Drugs like glucocorticoids, thiazides, dilantin and interferon alpha can also affect

insulin secretion. Certain viruses can also responsible for beta cell destruction [Figure 1].^{4,9}

Gestational DM is a glucose intolerance with onset of first recognition during pregnancy. High incidences seen in pregnant women with overweight and older pregnant women. In Majority of cases (70%) glucose regulation will return to normal after delivery.⁴ Around 30 % of women with history of Gestational DM will develop Type 2 DM with un 10 years after delivery.¹⁰

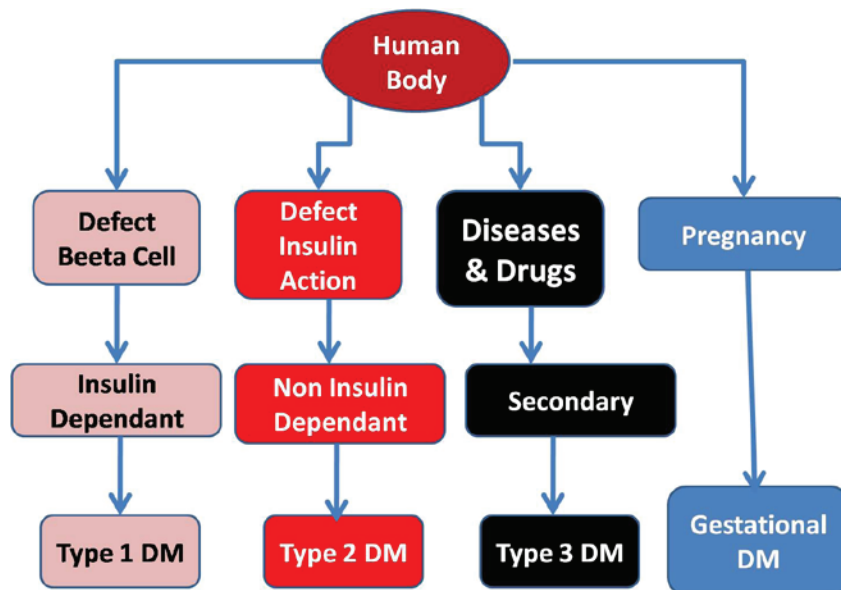


Figure 1: Types of DM

Clinical Signs & Symptoms:

In case of increased blood glucose level (Hyperglycemia), excessive urination occurs due to osmotic diuresis (Polyuria) and more glucose is excreted in the urine. Excessive loss of fluid leads to dehydration and excessive thirst (Polydipsia). It causes less glucose to body cells leads to increased hunger (Polyphagia). since the cells are unable to take up glucose, When this occurs, the body starts burning fat and muscle for energy, causing a reduction in overall body weight. These are signs and symptoms of DM.¹¹

In DM patient body’s natural buffering system is overwhelmed by the acidic ketones, this imbalance causes hyperventilation as the body attempts to regulate blood acid levels by getting rid of carbon dioxide in expired air.¹² People with uncontrolled DM have a higher chance of developing pancreatitis which causes swelling and inflammation of the pancreas, and may cause nausea, Vomiting and abdominal pain.¹³

Complications:^{14,15}

Long term DM patients have an increased incidence of oral and general both Microvascular and Macrovascular complications [Table 2]. Microvascular complications are retinopathy causes loss of vision and nephropathy (Renal Failure).^{16,17} Macrovascular complications are hypertension, hyperlipidemia, atherosclerotic cardiovascular disease and cerebrovascular disease. Other common symptoms are numbness and tingling sensation of extremities, oral parasthesia and burning sensation. These changes are result from microvascular injury involving small blood vessels that supply nerves (vasa nervorum).¹⁸

Impaired wound healing and susceptible to infections seen in poorly controlled DM. Diabetic wound healing is impaired because less oxygen can reach the wound As a result of narrowed blood vessels, and the tissues do not heal as quickly.¹⁹

TABLE 2: Complications of DM	
Oral Complications	<ul style="list-style-type: none"> • Gingival & periodontal disease • Salivary gland dysfunction • Oral Infections • Oral neuropathy
Long term complications	<ul style="list-style-type: none"> • Retinopathy • Nephropathy • Neuropathy • Macro vascular disease • Alteration in wound healing

ORAL MANIFESTATIONS OF DIABETES MELLITUS:

There are various oral manifestations reported in uncontrolled DM patients [Table 3]. These manifestations may relate to excessive loss of body fluids, altered response to infection, microvascular changes and increased glucose concentration in saliva.^{8,20,21}

TABLE 3: Oral Manifestations of DM
<ul style="list-style-type: none"> • Gingivitis & Periodontal disease • Alveolar Bone Loss • Oral Candidiasis • Median Rhomboid Glossitis • Xerostomia • Dental caries • Acute oral Infection • Dry Socket • Halitosis • Tingling & Numbness • Taste disturbances • Burning Pain In The Oral Region • Lichenoid Reaction

GINGIVITIS & PERIODONTAL DISEASE: DM is a confirmed major risk factor for periodontitis. Risk increased in 3 times in patients with DM. the level of glycemic control is key importance in determining increased risk. Periodontitis is referred as sixth complication of DM and in 2003 ADA acknowledged this. Diabetes increases inflammation in the gingival and

periodontal tissues leads to halitosis. Both type 1 and type 2 diabetes mellitus are associated with elevated levels of systemic markers of inflammation. The elevated inflammatory state in diabetes contributes to both microvascular and macrovascular complications, and hyperglycaemia can result in the activation of pathways that increase inflammation, oxidative stress and apoptosis.^{22,23}

Elevated levels of CRP are also associated with insulin resistance, type 2 diabetes mellitus. The systemic inflammation that is associated with gingival and periodontal disease may therefore enhance the diabetic state. Adipokines may also contribute to susceptibility to both periodontitis and diabetes, and the proinflammatory properties of leptin may be particularly important in upregulating periodontal inflammation in people who are obese and have type 2 diabetes mellitus.²⁴ Diabetes also prolongs the inflammatory response to *Porphyromonas gingivalis*, a periodontal pathogen commonly found in the biofilm of patients with advanced gingivitis and periodontitis.²⁵

ORAL CANDIDIASIS : Oral Thrush is a common problem and particularly for people with DM. Higher levels of glucose in the blood make candida all the more likely, so DM patients who have difficulty in controlling their blood sugar may find themselves particularly prone to fungal infections. Yeast feeds off of sugar. If DM isn't well-controlled, blood sugar levels can increase to high levels. This increase in sugar can cause yeast to overgrow, particularly in the oral region. So body may develop a fungal infection in response.²⁶ Oral candidiasis

can be diagnosed by the differential patterns of mucosal changes like erythematous, pseudomembranous, and curd-like plaques.²⁷

XEROSTOMIA : High blood sugar level cause dry mouth in people with both types of DM. The reason for these problems could be due to damage to the gland parenchyma, alterations in the microcirculation to the salivary glands, dehydration by hyperglycemia, disturbances in glycemic control, diabetic neuropathy, structural changes in the salivary glands and medications used to treat DM. The increased diuresis in people with DM leads to a significant decrease in extracellular fluids that directly affects salivary production. According to Moore, in periods of metabolic disorder, dehydration raises the osmotic gradient from the blood vessels in relation to the salivary glands, limiting saliva secretion and therefore exacerbating xerostomia symptoms.²⁸

DENTAL CARIES: Due to the low sugar diet

by most of DM patients , there is a reduced carious lesions, however reduced salivary flow rate caused by hyperglycemia causes glucose leakage into the oral cavity thereby facilitating the growth of aciduric and acidogenic bacteria and caries lesion development. If the patients also has oral fungal infections and under topical antifungal medications, these medications have high sugar content and also can promote caries.²⁹

ACUTE ORAL INFECTION

:Patients with diabetes are more susceptible to the development of various oral infections. As high blood sugar levels and the absence of its antimicrobial effects can weaken the patient’s immune system defences can cause these infections. In addition, some diabetes-related health issues, such as nerve damage and reduced blood flow to the extremities, increase the body’s vulnerability to infection [Figure 2].³⁰

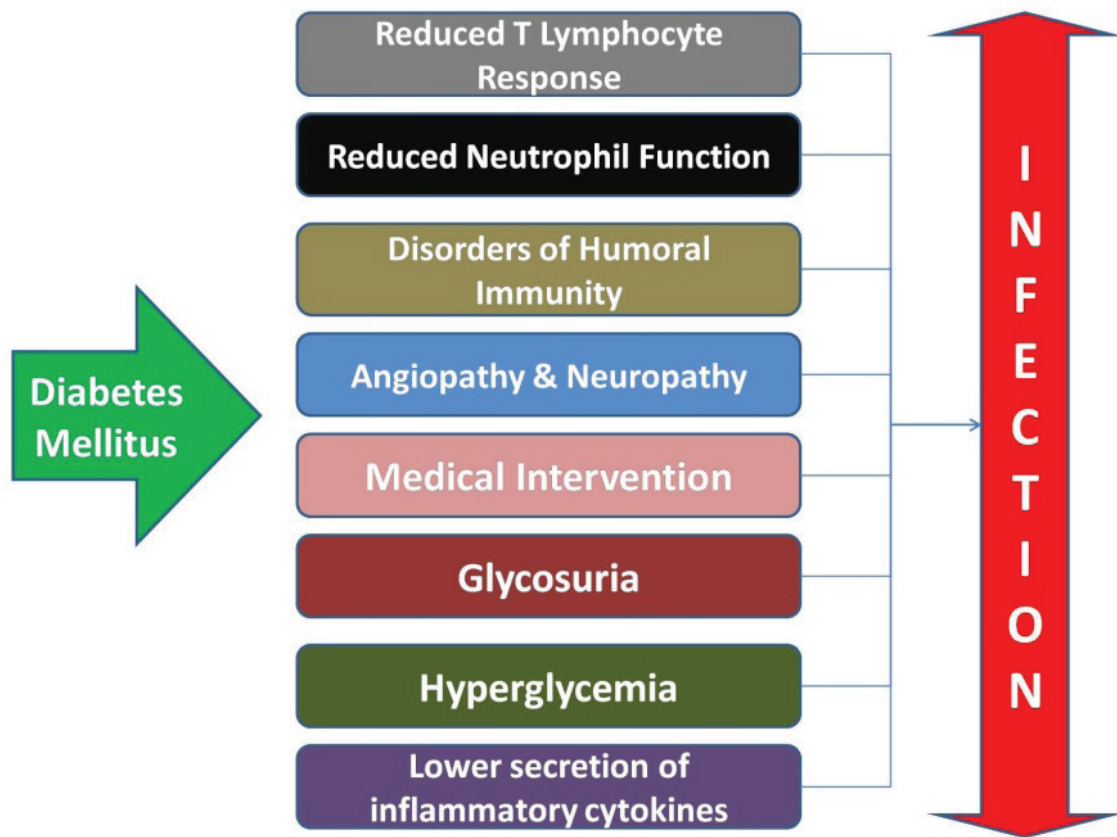


Figure 2: Pathophysiology of Infections Associated with DM

TINGLING & NUMBNESS :Uncontrolled high blood sugar damages nerves and interferes with their ability to send signals, leading to diabetic neuropathy. High blood sugar also weakens the walls of the small blood vessels (capillaries) that supply the nerves with oxygen and nutrients. Symptoms depend on the site of nerve damage and can include motor changes such as weakness; sensory symptoms such as numbness, tingling, pain or autonomic changes such as urinary symptoms. Tingling and numbness is usually peripheral neuropathy, or nerve damage in the arms, legs, hands, and feet. ³¹

TASTE DISTURBANCES: Diabetes can sometimes cause a sweet taste in the mouth and is often accompanied by other symptoms. Additional symptoms include: reduced ability to taste the sweetness in foods. among diabetic or prediabetic patients, 5.7% had a sweet taste disorder and 8.6% had a salt taste disorder. Neuropathy also increases the threshold of taste. This sensory dysfunction can inhibit the ability to maintain a good diet and can lead to poor glucose regulation. ³²

BURNING PAIN IN THE ORAL REGION :Neuropathic pain in these patients can be manifested as burning pain or even as electric shock or stabbing sensation that these symptoms may be very debilitating. These pain sensations have a considerable effect on the

physical and psychological functions. These Burning sensation or dysesthesia in the oral cavity of DM patients due to poor glycemic control, metabolic alterations in oral mucosa, angiopathy, candida infection, and neuropathy. ³³

LICHENOID REACTION :Little evidence supports a connection between diabetes mellitus and oral lichen planus. The oral lichenoid reaction in triad of oral lichen planus, diabetes mellitus, and hypertension (Grinspan syndrome) is probably an adverse effect of the drug therapy for diabetes mellitus and hypertension. ³⁴

EMERGENCY IN DENTAL CLINICS:

The emergency situation most likely encountered in the dental office is a patient with hypoglycemia or insulin shock. This condition is caused by an excessively high level of insulin due to the patient taking their daily dose of insulin with inadequate intake of carbohydrates. Symptoms of hypoglycaemia may range from mild, such as anxiety, sweating and tachycardia, to severe, such as mental status changes, seizure and coma. If dentists suspects that patient shows any symptoms of hypoglycaemia, they should immediately terminate dental treatment and administer immediately 15 g of a fast acting oral carbohydrates such as glucose tablets, sugar , soft drinks or juice[**Table 4**].³⁵

TABLE 4: Emergencies of DM Patients in Dental Office

Hypoglycaemia	INSULIN SHOCK	Acute emergency symptoms: <ul style="list-style-type: none"> • Confusion • Sweating • Tremors • Agitation • Anxiety • Dizziness • Tingling or numbness • Tachycardia • Seizures • Loss of consciousness.
Hyperglycemia	DIABETIC KETOACIDOSIS	No acute emergency symptoms

Hyperglycemia is Due to Low or absent plasma insulin levels for a long period of time. Because of the absence of insulin, glucose cannot enter cells, forcing the cells to metabolize fat and proteins to produce glucose. In the process ketones and other metabolic acids are produced leading to a condition known as diabetic ketoacidosis which, if not treated over a period of days, can lead to coma and death. The risk of hyperglycaemic crisis is lower than that of hypoglycaemia in dental clinic. Because it takes several days for ketoacidosis to occur, hyperglycemic patients do not exhibit acute emergency symptoms.³⁵

DENTAL CONSIDERATIONS:

To provide competent care to DM patients, dental clinicians must understand the disease, its treatment, and its impact on the patients’ ability to undergo and respond to dental care. To minimise the risk of an intraoperative emergency, clinicians need to consider some issues before initiating dental treatment.³⁶ We have to follow few general guidelines while treating DM patients. [Table 5]

A.	Take physicians consent
B.	Treatment in hospital setting
C.	Detailed Medical history
D.	Morning short appointments
E.	Check glucose level
F.	Continuous verbal contact with patients
G.	Monitor pulse, respiration & BP
H.	Defer any minor surgical procedures

It is always advisable to consult a patient’s physician before any surgical procedure to consider adjustment of the patient’s insulin and dosage and dietary needs during the postoperative period. In a poorly controlled diabetic, prophylactic antibiotic should be considered due to altered function of neutrophils. To minimize the risk of emergency dentists should consider few management steps before dental treatment [Table 6].

TREATMENT	DENTAL CONSIDERATION
Orthodontic Treatment 37	<ul style="list-style-type: none"> • DM is not a contraindication for orthodontic treatment • Patients should have control of their glycaemic state • Under proper monitoring before starting active orthodontic treatment • Should apply light physiological force on teeth • Antibiotic prophylaxis for band and separator placement and orthodontic implant placement • For simple appliance, Antibiotic not required • Dentist should be trained in management of hypoglycaemic condition
Oral Surgical Procedures 38	<ul style="list-style-type: none"> • Check blood glucose prior to procedure • Pre and post surgical antibiotics • Increase insulin dose in case of infection and delayed wound healing • Max permissible blood glucose level is fasting 180mg/dL & random 200mg/dL • In case of emergency procedures cut off point is max 234mg/dL • Dry socket is the complication • An early morning appointment will minimize the risk of stress-induced hypoglycemia
Periodontal Treatment 39	<ul style="list-style-type: none"> • Proper periodontal treatment is associated with reduction of HbA1c level • Blood glucose level should be fasting 160mg/dL • Routine periodontal assessment should be performed • Ask the patients about their level of glycaemic control • Patient education, oral hygiene instruction & monitoring treatment outcome • Conventional periodontal treatment is very effective in DM • Antibiotics as a part of periodontal therapy

Cont... TABLE 6: Dental Considerations of DM Patients During Treatment

Endodontic Treatment 40	<ul style="list-style-type: none"> • Well controlled and free of complication patients are fit for treatment • Special consideration for acute infections • Acute infections managed with drainage, pulpectomy & antibiotics • Insulin doses should be increased if required • Early morning appointments • Pretreatment sedation, if required • Antibiotic prophylaxis not required for well controlled cases
Prosthetic Treatment 41	<ul style="list-style-type: none"> • Stress reduction • Oral hygiene instructions • Mucostatic impressions • Uncontrolled cases, implants are contraindicated • Complications are –Abutment failure, tissue abrasions and fungal infections in denture patients, increased residual ridge resorption

It's very important for clinician to take detailed medical history of the DM patient. When reviewing medical histories, a clinician should be aware of the cardinal signs of DM. Should also ask about any hypoglycaemic episodes and recent test details and history of antidiabetic and other medications. There are variety of medications can alter blood glucose levels in the body. Few major surgical procedures may require adjustments in insulin or antidiabetic medication doses. Appointments should be scheduled at early morning since endogenous cortisol levels are generally higher at this time (cortisol increases blood sugar levels). For patients receiving insulin therapy, appointments should be scheduled so that they do not coincide with peaks of insulin activity, since this is the period of maximal risk of developing hypoglycaemia. Dentists should ensure that the DM patients has eaten normally and taken their medications. If patient skip the meal and takes the normal dose of insulin, then risk of hypoglycaemic episode is more. Patients with poorly controlled DM are at greater risk of developing post treatment infections and delayed wound healing. Therefore antibiotic coverage is necessary for such patients.⁴

Conclusion

Oral complications in patients with DM are considered major complications of the disease and can impress the patients' quality of life. Patients with poorly controlled DM must be considered at risk for

oral complications and they should be informed of this risk. There is evidence that chronic and persistent oral complications in these patients adversely affect blood glucose control. Thus, prevention and management of oral complications due to diabetes are more important. Fully aware of managing medically compromised patients with different treatment modalities and cooperating with consulting patient's physicians is a key responsibility of a oral physician.

Conflict of Interest: Nil

Source of Funding: Self

Ethical Clearance: Taken from Institutional Ethical Committee

Referances

1. Martí Álamo S, Jiménez Soriano Y, Sarrión Pérez MG. Dental considerations for the patient with diabetes. *J Clin Exp Dent.* 2011;3(1):e25-30.
2. Little JW, Falace DA, Miller CS, Rhodus NL. *Dental management of the medically compromised patients.* 6th ed. St. Louis: Mosby;2002:154,248-70.548-632.
3. Miley DD, Terezhalmly GT. *The patient with diabetes mellitus: etiology, epidemiology, principles of medical management, oral disease burden, and principles of dental management.* *Quintessence Int.* 2005 Nov-Dec;36(10):779-95
4. Rajesh V. Lalla, Joseph A. D'ambrosio. Dental management considerations for the patient with

- diabetes mellitus. *JADA* 2001; Volume 132, Issue 10, Pages 1425–1432
5. Miedema K. “Standardization of HbA1c and Optimal Range of Monitoring”. *Scandinavian Journal of Clinical and Laboratory Investigation*. 2005;240: 61–72.
 6. Gray H, Rahilly SO. Towards improved glycaemic control in diabetes. What’s on the horizon. *Arch Intern Med* 1994;155;1137
 7. Boden G. Pathogenesis of type 2 Diabetes: insulin resistance. *Endocrinol Metal Clin North Am* 2001;30:801-15
 8. Aggarwal A, Gupta A, Sharma P, Pandey R, Garg B, Kumar S. Dental management of Diabetes Mellitus: Review of Literature. *J Res Adv Dent* 2018;7:3:73-77
 9. Report of The Expert Committee On The Diagnosis And Classification Of Diabetes Mellitus. *Diabetes Care* 2000;23;S4-S19.
 10. Donovan PJ, McIntyre HD. “Drugs for gestational diabetes”. *Australian Prescriber*. 2010;33 (5): 141–144.
 11. Luc Van Gaal & Andre Scheen. Weight Management in Type 2 Diabetes: Current and Emerging Approaches to Treatment. *Diabetes Care* 2015 Jun; 38(6): 1161-1172.
 12. Alice Gallo de Moraes and Salim Surani. Effects of diabetic ketoacidosis in the respiratory system. *World J Diabetes*. 2019 Jan 15; 10(1): 16–22
 13. K H Soergel, N J Greenberger. Nausea and Vomiting in the Diabetic Patient. *Hosp Pract* .1998; 15;33(2):43-5, 49-50, 56-61doi: 10.1080/21548331.1998.11443633.
 14. Bergmen SA, Perioperative management of the diabetic patient. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;103:731-7
 15. Tan WC, Tay FB, Lim LP. Diabetes as a risk factor for periodontal disease: current status and future considerations. *Ann Acad Med Singapore*. 2006;35;571-81
 16. Behl T, Kaur I, Kotwani A (Jun 2015). “Implication of oxidative stress in progression of diabetic retinopathy”. *Surv Ophthalmol*. 61 (2): 187–196. doi:10.1016/j.survophthal.2015.06.001. PMID 26074354
 17. Forbes, JM, Coughlan MT, Cooper ME). “Oxidative stress as a major culprit in kidney disease in diabetes”. *Diabetes*. 2008;57 (6): 1446–1454. doi:10.2337/db08-0057. PMID 18511445. Archived from the original on 2009-04-15.
 18. “What Is Microvascular Cranial Nerve Palsy?”. *aa.org*. 1 September 2017. Archived from the original on 22 December 2017.
 19. Dimitrios Baltzis, Ioanna Eleftheriadou, Aristidis Veves. Pathogenesis and Treatment of Impaired Wound Healing in Diabetes Mellitus: New Insights. *Adv Ther*. 2014 Aug;31(8):817-36. doi: 10.1007/s12325-014-0140-x. Epub 2014 Jul 29.
 20. Campus G et al. Diabetes and periodontal disease: A case control study. *J Periodontol* 2005;76(3):418-25
 21. Pontes Anderson CC, Flyvbijerg A, Buschard K, Holmstrup P. Relation ship between periodontitis and diabetes: Lessons from rodent studies. *J Periodontol* 2007;78:1264-75.
 22. Dandona P, Aljada A, Bandyopadhyay A. Inflammation: the link between insulin resistance, obesity and diabetes. *Trends Immunol*. 2004;25:4–7. doi: 10.1016/j.it.2003.10.013.
 23. Brownlee M. The pathobiology of diabetic complications: a unifying mechanism. *Diabetes*. 2005;54:1615–1625. doi: 10.2337/diabetes.54.6.1615.
 24. Preshaw PM, Foster N, Taylor JJ. Cross-susceptibility between periodontal disease and type 2 diabetes mellitus: an immunobiological perspective. *Periodontol* 2000. 2007;45:138–157. doi: 10.1111/j.1600-0757.2007.00221.x.
 25. Naguib G, Al-Mashat H, Desta T, Graves DT. Diabetes prolongs the inflammatory response to a bacterial stimulus through cytokine dysregulation. *J Invest Dermatol*. 2004;123:87–92. doi: 10.1111/j.0022-202X.2004.22711.
 26. Gary A Bartholomew, Brad Rodu, and David S Bell. Oral Candidiasis in Patients With Diabetes Mellitus: A Thorough Analysis. *Diabetes Care* 1987 Sep; 10(5): 607-612.
 27. Neville B.W., Damm D.D., Allen C.M., Chi A.C. In *Fungal and Protozoal Diseases*. Elsevier; London, UK: 2011. Oral and maxillofacial pathology; pp. 213–221.
 28. Moore PA, Guggenheimer J, Etzel KR, Weyant RJ, Orchard T. Type 1 Diabetes Mellitus, xerostomia, and salivary flow rates. *Oral Surg Oral Med Oral*

- Pathol Oral Radiol Endod 2001; 92: 281-91
29. Lin BP, Taylor GW, Alen DJ, Ship JA. Dental caries in older adults with diabetes mellitus. *Special care dentistry* 1999;19(1):8-14
 30. Juliana Casqueiro, Janine Casqueiro, and Cresio Alves. Infections in patients with diabetes mellitus: A review of pathogenesis. *Indian J Endocrinol Metab.* 2012 Mar; 16(Suppl1): S27–S36.
 31. Javed S, Petropoulos IN, Alam U, Malik RA (Jan 2015). “Treatment of painful diabetic neuropathy”. *Ther Adv Chronic Dis.* 2015; 6 (1): 15–28. doi:10.1177/2040622314552071
 32. Khan T. Oral manifestations and complications of diabetes mellitus: A review. *Int J Med Health Res.* 2018;4:50–52.
 33. Cicmil S, Mladenović I, Krunić J, Ivanović D, Stojanović N. Oral Alterations in Diabetes Mellitus. *Balk J Dent Med.* 2018;22:7–14.
 34. Hamid Reza Mozaffari,¹ Roohollah Sharifi,² and Masoud Sadeghi. Prevalence of Oral Lichen Planus in Diabetes Mellitus: a Meta-Analysis Study. *Acta Inform Med.* 2016 Dec; 24(6): 390–393. doi: 10.5455/aim.2016.24.390-393
 35. Cryer PE, Davis SN, Shamon H. Hypoglycemia in diabetes. *Diabetes Care* 2003 Jun; 26(6):1902-12
 36. Ship JA. Diagnosing, managing and preventing salivary gland disorder. *Oral Dis*2002;8(2):77-89
 37. Ahmed Almadih, Maryam Al-Zayer, Sukainh Dabel, Ahmed Alkhalaf, Ali Al Mayyad, Wajdi Bardisi, Shouq Alshammari, and Zainab Alsihati- Orthodontic Treatment Consideration in Diabetic Patients. *J Clin Med Res.* 2018 ; 10(2): 77–81.
 38. Giath Gazal. Management of an emergency tooth extraction in diabetic patients on the dental chair. *Saudi Dent J.* 2020 Jan; 32(1): 1–6.
 39. Mealey B L, Ocampo G L. Diabetes mellitus and periodontal disease. *Periodontol* 2000 2007; 44: 127–153.
 40. Chakravarthy PV. Diabetes mellitus: An endodontic perspective. *Eur J Gen Dent* 2013;2:241-5.
 41. Kansal G, Goyal D. Prosthodontic Management of Patients With Diabetes Mellitus. *J Adv Med Dent Scie Res* 2013;1(1):38-44