

DIABETES AND ORAL HEALTH CONSIDERATIONS: A REVIEW.

Aayush Ranjan Deb¹, Neal Bharat Kedia², Sidharth Kaul³, Akshara Gandikota⁴, Anjali Koul⁵, Sonali Kumari⁶

ABSTRACT :

Diabetes Mellitus is now a global epidemic. With the rise in oral complications associated with diabetes, the dentists are concerned about the morbidity related to these. Oral health considerations involve those relating to adverse effects on gums, teeth, tongue as well as the delay in wound healing. Many a times, diabetics suffer discomfort and are not able to maintain proper oral hygiene owing to these oral complications thereby leading to significant rise in morbidity and mortality. It is imperative that such patients be made aware of the relationship that exists between oral hygiene and diabetes.

KEYWORDS: Diabetes Mellitus, Oral complications, Oral health.

INTRODUCTION:

The human body is incredible as it possesses ability to maintain a stable and constant internal environment. It depends on hormones and chemical signalling pathways to respond to external stresses, such as changes in temperature, pH and blood glucose levels, through its complex and well-regulated endocrine system. This steady state is termed "homeostasis." However many a times this balance is disturbed leading to disorders. Diabetes mellitus (DM) refers to a group of metabolic disorders in which the body's ability to produce or respond to insulin is impaired.¹ This results in abnormal carbohydrate metabolism that eventually leads to elevated blood glucose levels. As Martin Silink, past-president of the International Diabetes Foundation (2003-2006), expressed, 'diabetes is understood by few and ignored by many'.² Diabetes is a condition where the body either fails to

produce insulin (Type 1 diabetes) or the insulin that is produced is no longer as effective (Type 2 diabetes). Ketoacidosis or severe hypoglycaemic conditions can be encountered by diabetic patients. Patients with chronic diabetes are prone to affect the oral environment³ and adversely effect their kidneys (nephropathy), nerves (neuropathy), eyes (retinopathy), liver (non-alcoholic fatty liver) with generalized weight gain (obesity).⁴ Oral complications affecting the gum and teeth are quite common³ and this negatively affects their quality of life (QoL).⁵

DIABETES AND PERIODONTAL CONSIDERATIONS:

Periodontitis is the inflammation of the tissues surrounding the teeth causing these soft and hard tissues to shrink, thereby leading to loosening and loss of teeth. Patients with diabetes have been found to invariably have inflammatory periodontal issues,^{6,7} and if the control is poor the severity is even more.^{6,8} Hyperglycaemia associated with diabetes may lead to increase,^{9,10} decrease^{9,11} or change,^{12,13} in subgingival microbiota affecting periodontal tissues. The accumulation of plaque micro-organisms in diabetic patients causes irreversible periodontal tissue destruction.^{14,15}

DIABETES AND ORAL CANDIDIASIS:

The high prevalence of oral candidiasis in diabetic patients,¹⁶ is due to the immunosuppressive effect of Diabetes Mellitus on the patient which causes the

Corresponding Author : Dr. Anjali Koul

¹ Intern, Sri Ramachandra Dental College and Hospital, Chennai, Tamil Nadu.

² Professor, Dept. of Orthodontics and Dentofacial Orthopaedics, Buddha Institute of Dental Sciences and Hospital, Patna, Bihar.

³ BDS student, Jagadguru Sri Shivarathreshwara Dental College and Hospital, Mysuru, Karnataka.

⁴ Intern, Sri Ramachandra Dental College and Hospital, Chennai, Tamil Nadu.

⁵ Associate Professor, Dept. of Orthodontics and Dentofacial Orthopaedics, Buddha Institute of Dental Sciences and Hospital, Patna, Bihar.

⁶ Senior Lecturer, Department of Periodontology, Vananchal Dental Sciences and Hospital, Garhwa, Jharkhand.



normal commensal yeast, *Candida albicans* to stick to oral mucosa leading to Candidiasis.¹⁷

DIABETES AND HALITOSIS:

Odoriferous microorganism which produce volatile sulphur compounds leading to malodor have been found to be present in higher numbers in subgingival plaque and tongue coating of diabetic patients.¹⁸

Halitosis was found to be about 52% in patients with controlled diabetes while 76% patients with uncontrolled diabetes had oral malodour.¹⁹

DIABETES AND CARIES:

Diabetes Mellitus favours growth of acidogenic bacteria as hyperglycaemia is responsible for increased levels of fermentable carbohydrates, hence such patients are prone to carious teeth,²⁰ and superimposed with improper oral hygiene maintenance, the carious lesions percolate down the root canals and hence periapical pathologies are more prevalent.^{21,22}

DIABETES AND IMPLANTS CONSIDERATIONS:

In patients with Diabetes Mellitus the implants take longer time to osseointegrate,²³ More so in patients with poorly controlled glucose levels.²⁴ The breakdown of the peri-implant tissues is much more in patients with hyperglycaemia, irrespective of whether they are smokers or not.^{25,26}

DIABETES AND SALIVARY EFFECTS:

Diabetes leads to decrease in the production of saliva (hyposalivation) or in some patients xerostomia leading to dry mouth. Since saliva is home to oral microbiomes, underproduction of saliva leads to changes in their composition.²⁷ The increase in acidic oral environment is detrimental to the hard and soft tissues and leads to caries and periodontal problems; as well as difficulty in chewing, swallowing and speaking.²⁸

DIABETES AND TASTE CHANGES:

Diabetes Mellitus leads to taste disturbances because of its direct effect on the nerves supplying the taste buds.²⁹ Hence patients with Diabetes Mellitus frequently complain of taste impairment.³⁰

DIABETES AND BURNING MOUTH SYNDROME:

Diabetes Mellitus due to hyperglycaemia affect the microvasculature thereby leading to neuropathy and hence contributes to the complex burning mouth syndrome. A transdisciplinary approach is sought to deal with other local and systemic factors.^{31,32}

DIABETES AND WOUND HEALING:

Patients with diabetes are more prone to develop infections in the oral cavity and have slow healing wounds.^{33,34} This is mainly because the oral bacterial infections get an environment where hyperglycaemic conditions are superimposed upon a weak immune system of the diabetic patient.³³

Hyperglycaemia effects the lining of blood vessels making them less flexible; with the result small blood vessels are damaged and hence severely hampering healing of wounds.^{34,35}

DIABETES AND CANCER:

Patients with Diabetes Mellitus are more prone to cancer.³⁶ The delayed wound healing in patients with Diabetes Mellitus aggravates the oral wounds and leads to increased risk of developing traumatic ulcers and disorders of temporomandibular joint: as well as development of benign migratory glossitis and fissured tongue.³

DIABETES AND OSTEONECROSIS OF THE JAW:

Diabetes affects the peripheral microvasculature leading to decrease in nutrition to the jaw bone affecting both osteoblastic and osteoclastic activity required for remodelling.³⁷ Hence the patient is predisposed to Osteonecrosis of the jaw (ONJ).^{38,39}

DIABETES AND COGNITIVE FUNCTION:

The impairment of glucose metabolism in patients with Diabetes Mellitus causes cognitive decline.⁴⁰

Hence such patients can progressively have Alzheimer's disease; which has been named "type 3 DM."⁴¹

DIABETES AND SARS-COV-2 VIRUS:

COVID-19 patients with underlying co-morbidities like Diabetes Mellitus are at a risk of developing painful ulcers,^{42,43} and necrotizing periodontitis.⁴⁴

Alternatively patients with Diabetes Mellitus having



periodontitis can act as harbours to SARS-CoV-2 virus,^{45,46} in their periodontal pockets.^{45,47} and gingival crevicular fluid⁴⁸; thereby increasing the mortality rate of diabetic patients infected with the virus.⁴⁹

DIABETES AND QUALITY OF LIFE:

Oral health and Quality of life (QoL) are strongly related to each other,⁵⁰ hence focus on improving oral health conditions is important in Diabetes Mellitus.^{51,52} Since patients with Diabetes Mellitus suffer from tooth loss due to periodontal or periapical pathologies, their masticatory efficiency is compromised. Moreover, the use of partial or complete (fixed or removable) prosthesis is problematic due to salivary and mucosal changes. Chewing of healthy whole grain products as well as fruits and vegetables which are hard but laden with much needed nutrients and fibers is quite challenging.^{53,54} This compels them to switch to softer and processed foods which are easy on the oral apparatus but at the same time have high glycaemic index score⁵⁵; loaded with not only sugar and fat but devoid of nutrients.⁵⁶

DENTAL MANAGEMENT CONSIDERATIONS:

Before initiating treatment of a diabetic patient, dentists must appreciate important dental management considerations. In doing so, dentists can help to minimize the risk of an intraoperative diabetic emergency and reduce the likelihood of an oral complication of the disease.

THESE INCLUDE:

- Consult with patient's physician to assess diabetes control
- Confirm that patient has eaten and taken medications before initiating treatment
- Anticipate and be prepared to manage hypoglycaemia
- Prevent, treat and eliminate infections promptly
- Do not use or recommend aspirin-containing compounds
- Achieve profound local anesthesia
- Ensure excellent oral hygiene and provide profound preventive care

- Reinforce regular diet and medication regimen before and after dental appointments
- Take glucometer reading if patient is high risk, on insulin or having surgery

Cortisol is an endogenous hormone that increases blood glucose levels. Because cortisol levels are typically higher in the morning and during times of stress (e.g., a dental procedure), it is advisable that diabetic patients are scheduled for morning appointments.⁵⁷ In taking this precaution, the dentist reduces the risk of a hypoglycemic episode.

The most common intraoperative complication of DM is a hypoglycemic episode.⁵⁷ The risk is highest during peak insulin activity, when the patient does not eat before an appointment or when oral hypoglycemic medication and/or insulin levels exceed the needs of the body. Initial signs and symptoms of hypoglycemia include hunger, fatigue, sweating, nausea, shaking, irritability and tachycardia.⁵⁸

If a hypoglycemic episode is suspected, the dentist should stop dental treatment immediately and administer 15 g of oral carbohydrate via a candy, juice or glucose tablet.⁵⁹ If the patient is unconscious or cannot swallow, the dentist should seek medical assistance. Following treatment, the dentist must remember that diabetic patients are prone to infections and delayed wound healing. This is especially true for a diabetic patient whose condition is uncontrolled. Therefore, depending on the dental procedure, some consideration should be given to providing antibiotic coverage. If treatment will result in an interruption to the normal dietary regimen, the dentist should consult the patient's physician regarding a potential adjustment of insulin and antidiabetic medication doses. Notably, salicylates are known to potentiate the effect of oral hypoglycaemic agents by increasing insulin secretion and sensitivity.⁶⁰ To avoid unintended hypoglycaemia, aspirin-containing compounds should not be used by patients with DM.

PREVENTION OF ORAL MANIFESTATIONS:

The current body of evidence is not enough to prevent type 1 DM.⁶¹ Oral manifestations of type 2 DM can be



prevented through several approaches that are aimed at ensuring proper brushing and flossing behaviours, encouraging patients to visit the dentist for a routine check-up and controlling blood glucose levels.⁶²

The patients with dentures should be advised to remove dentures at night and keep them properly cleaned.⁶² Giving oral health education to relatives and friends could be beneficial as well because more than 55% of DM patients could be influenced by them.⁶³ The Internet can be used to educating DM patients because of its growing use among people.⁶⁴ It was reported that prediabetic patients were found to have deteriorated periodontal health as demonstrated by worse periodontal parameters, and glycemic control was shown to reduce the severity of these parameters.⁶⁵ Early identification, assessment, and management of patients who are at risk of developing DM require a dentist's active role in diagnosing the condition in previously undiagnosed individuals.

CONCLUSION:

Diabetes Mellitus is a public health crisis and health care professionals should play their roles to prevent and control the disease and its oral and other systemic complications. There is a high prevalence of DM, especially in high and middle-income countries. In addition to millions of people diagnosed with DM, a considerable proportion of the population is undiagnosed. The condition causes huge economic and financial burden to the healthcare systems in addition to increased morbidity and mortality. Oral complications of DM are numerous and include periodontal disease, hyposalivation, dental caries, halitosis, delayed wound healing, taste and salivary dysfunctions, candidiasis, and burning mouth syndrome. Increasing awareness and knowledge about the DM, its association with oral health including oral complications among patients can help prevent DM and improve their quality of life.

REFERENCES:

1. American Diabetes Association. Standards of medical care in diabetes-2011. *Diabetes care.* 2011;34(Supplement 1):S11-S61.
2. Silink M. Turning points in the fight against diabetes. *Diabetes Voice* 2008; 52: 2.

3. Verhulst MJL, Loos BG, Gerdes VEA, Teeuw WJ. Evaluating all potential oral complications of diabetes mellitus. *Front Endocrinol.* (2019) 10:56.
4. Comprehensive medical evaluation and assessment of comorbidities: standards of medical care in diabetes - 2021. *Diabetes Care.* (2021) 44:S40-52.
5. Verhulst MJL, Teeuw WJ, Gerdes VEA, Loos BG. Self-reported oral health and quality of life in patients with type 2 diabetes mellitus in primary care: a multi-center cross-sectional study. *Diabetes Metab Syndr Obes.* (2019) 12:883-99.
6. Kocher T, König J, Borgnakke WS, Pink C, Meisel P. Periodontal complications of hyperglycemia/diabetes mellitus: epidemiologic complexity and clinical challenge. *Periodontol 2000.* (2018) 78:59-97.
7. Wu CZ, Yuan YH, Liu HH, Li SS, Zhang BW, Chen W, et al. Epidemiologic relationship between periodontitis and type 2 diabetes mellitus. *BMC Oral Health.* (2020) 20:204.
8. Genco RJ, Borgnakke WS. Diabetes as a potential risk for periodontitis: association studies. *Periodontol 2000.* (2020) 83:40-5.
9. Saeb ATM, Al-Rubeaan KA, Aldosary K, Udaya Raja GK, Mani B, Abouelhoda M, et al. Relative reduction of biological and phylogenetic diversity of the oral microbiota of diabetes and pre-diabetes patients. *Microb Pathog.* (2019) 128:215-29.
10. Farina R, Severi M, Carrieri A, Miotto E, Sabbioni S, Trombelli L, et al. Whole metagenomic shotgun sequencing of the subgingival microbiome of diabetics and non-diabetics with different periodontal conditions. *Arch Oral Biol.* (2019) 104:13-23.
11. Scannapieco FA, Dongari-Bagtzoglou A. Dysbiosis revisited; understanding the role of the oral microbiome in the pathogenesis of gingivitis and periodontitis: a critical assessment. *J Periodontol.* (2021). doi: 10.1002/JPER.21-0120. [Epub ahead of print].
12. Kori JA, Saleem F, Ullah S, Azim MK. Characterization of oral bacteriome dysbiosis in type 2 diabetic patients. *medRxiv.* (2020). doi: 10.1101/2020.04.09.20052613. [Epub ahead of print].
13. Matsha TE, Prince Y, Davids S, Chikte U, Erasmus RT, Kengne AP, et al. Oral microbiome signatures in diabetes mellitus and periodontal disease. *J Dent Res.* (2020) 99:658-65.
14. Van Dyke TE, Bartold PM, Reynolds EC. The nexus between periodontal inflammation and dysbiosis. *Front Immunol.* (2020) 11:511.



15. Bartold PM, Van Dyke TE. An appraisal of the role of specific bacteria in the initial pathogenesis of periodontitis. *J Clin Periodontol.* (2019) 46:6-11.
16. Jhugroo C, Divakar DD, Jhugroo P, Al-Amri SAS, Alahmari AD, Vijaykumar S, et al. Characterization of oral mucosa lesions and prevalence of yeasts in diabetic patients: a comparative study. *Microb Pathog.* (2019) 126:363-67.
17. Offenbacher S, Barros SP, Altarawneh S, Beck JD, Loewy ZG. Impact of tooth loss on oral and systemic health. *Gen Dent.* (2012) 60:494-500; quiz 501-2.
18. Kamaraj DR, Bhushan KS, Laxman VK, Mathew J. Detection of odoriferous subgingival and tongue microbiota in diabetic and nondiabetic patients with oral malodor using polymerase chain reaction. *Indian Journal of Dental Research.* 2011; 22(2):260.
19. Shrimali L, Astekar M, Sowmya GV. Correlation of oral manifestations in controlled and uncontrolled diabetes mellitus. *International Journal of Oral and Maxillofacial Pathology.* 2011; 2(4):24-7.
20. Swapna LA, Koppolu P, Prince J. Oral health in diabetic and nondiabetic patients with chronic kidney disease. *Saudi J Kidney Dis Transpl.* (2017) 28:1099-105.
21. Cabanillas-Balsera D, Martin-Gonzalez J, Montero-Miralles P, SanchezDominguez B, Jimenez-Sanchez MC, Segura-Egea JJ. Association between diabetes and nonretention of root filled teeth: a systematic review and meta-analysis. *Int Endod J.* (2019) 52:297-306.
22. Rios-Osorio N, Munoz-Alvear HD, Montoya Canon S, Restrepo-Mendez S, Aguilera-Rojas SE, Jimenez-Pena O, et al. Association between type 2 diabetes mellitus and the evolution of endodontic pathology. *Quintessence Int.* (2020) 51:100-7.
23. Oates TW, Dowell S, Robinson M, McMahan CA. Glycemic control and implant stabilization in type 2 diabetes mellitus. *J Dent Res.* (2009) 88:367-71.
24. Eskow CC, Oates TW. Dental implant survival and complication rate over 2 years for individuals with poorly controlled type 2 diabetes mellitus. *Clin Implant Dent Relat Res.* (2017) 19:423-31.
25. Meza Mauricio J, Miranda TS, Almeida ML, Silva HD, Figueiredo LC, Duarte PM. An umbrella review on the effects of diabetes on implant failure and peri-implant diseases. *Braz Oral Res.* (2019) 33:e070.
26. Monje A, Catena A, Borgnakke WS. Association between diabetes mellitus/hyperglycaemia and peri-implant diseases: systematic review and meta-analysis. *J Clin Periodontol.* (2017) 44: 636-48.
27. Wade WG. Resilience of the oral microbiome. *Periodontol 2000.* (2021) 86:113-22.
28. Lu TY, Chen JH, Du JK, Lin YC, Ho PS, Lee CH, et al. Dysphagia and masticatory performance as a mediator of the xerostomia to quality of life relation in the older population. *BMC Geriatr.* (2020) 20:521.
29. Balakumar P, Kavitha M, Nanditha S. Cardiovascular drugs-induced oral toxicities: a murky area to be revisited and illuminated. *Pharmacol Res.* (2015) 102:81-9.
30. Borgnakke WS, Anderson PF, Shannon C, Jivanescu A. Is there a relationship between oral health and diabetic neuropathy? *Curr Diab Rep.* (2015) 15:93.
31. Ritchie A, Kramer JM. Recent advances in the etiology and treatment of burning mouth syndrome. *J Dent Res.* (2018) 97:1193-9.
32. Silvestre FJ, Silvestre-Rangil J, López-Jornet P. Burning mouth syndrome: a review and update. *Rev Neurol.* (2015) 60:457-63.
33. Mohanty S, Mohanty N, Rath S. Analysis of oral health complications in diabetic patients - a diagnostic perspective. *J Oral Res.* 2018;7(8):278-281.
34. Jha R, Kalyani P, Bavishi R. Oral manifestations of diabetes. *J Res Med Dent Sci.* 2017;2(3):6-8.
35. Spampinato SF, Caruso GI, De Pasquale R, Sortino MA, Merlo S. The treatment of impaired wound healing in diabetes: looking among old drugs. *Pharmaceuticals (Basel).* 2020;13(4):60.
36. Miller B, Chalfant H, Thomas A, Wellberg E, Henson C, McNally MW, et al. Diabetes, obesity, and inflammation: impact on clinical and radiographic features of breast cancer. *Int J Mol Sci.* (2021) 22:2757.
37. Peer A, Khamaisi M. Diabetes as a risk factor for medication-related osteonecrosis of the jaw. *J Dent Res.* (2015) 94:252-60.
38. Ito R, Huang JJ, Hsieh WC, Kao HK, Lao WW, Fang KH, et al. Identification of predisposing factors for osteonecrosis of the jaw after marginal mandibulectomy in the surgical management of oral squamous cell carcinoma. *J Surg Oncol.* (2018) 117:781-87.
39. Khan A, Morrison A, Cheung A, Hashem W, Compston J. Osteonecrosis of the jaw (ONJ): diagnosis and management in 2015. *Osteoporos Int.* (2016) 27:853-9.
40. Kuehn BM. In Alzheimer research, glucose metabolism moves to center stage. *J Am Med Assoc.* (2020)



323:297-9.

41. de la Monte SM, Wands JR. Alzheimer's disease is type 3 diabetes-evidence reviewed. *J Diabetes Sci Technol.* (2008) 2:1101-13.
42. Ansari R, Gheitani M, Heidari F, Heidari F. Oral cavity lesions as a manifestation of the novel virus (COVID-19). *Oral Dis.* (2021) 27(Suppl.3):771-2.
43. Martín Carreras-Presas C, Amaro Sánchez J, López-Sánchez AF, Jané-Salas E, Somacarrera Pérez ML. Oral vesiculobullous lesions associated with SARSCoV-2 infection. *Oral Dis.* (2021) 27(Suppl. 3):710-2.
44. Elibol E. Otolaryngological symptoms in COVID-19. *Eur Arch Otorhinolaryngol.* (2021) 278:1233-6.
45. Lloyd-Jones G, Molyam S, Pontes CC, Chapple I. The COVID-19 pathway:a proposed oral-vascular-pulmonary route of SARS-CoV-2 infection and the importance of oral healthcare measures. *J Oral Med Dent Res.* (2021) 2:1-25.
46. Xu J, Li Y, Gan F, Du Y, Yao Y. Salivary glands:potential reservoirs for COVID-19 asymptomatic infection. *J Dent Res.* (2020) 99:989.
47. Räisänen IT, Umezudike KA, Pärnänen P, Heikkilä P, Tervahartiala T, Nwhator SO, et al. Periodontal disease and targeted prevention using aMMP8 point-of-care oral fluid analytics in the COVID-19 era. *Med Hypotheses.*(2020) 144:110276.
48. Gupta S, Mohindra R, Chauhan PK, Singla V, Goyal K, Sahni V, et al. SARSCoV-2 detection in gingival crevicular fluid. *J Dent Res.* (2021) 100:187-93.
49. Bode B, Garrett V, Messler J, McFarland R, Crowe J, Booth R, et al. Glycemic characteristics and clinical outcomes of covid-19 patients hospitalized in the United States. *J Diabetes Sci Technol.* (2020) 14:813-21.
50. Sekulic S, John MT, Davey C, Renner-Sitar K. Association between oral health-related and health-related quality of life. *Zdr Varst.* (2020) 59:65-74.
51. Machado V, Botelho J, Proença L, Alves R, Oliveira MJ, Amaro L, et al. Periodontal status, perceived stress, diabetes mellitus and oral hygiene care on quality of life: a structural equation modelling analysis. *BMC Oral Health.*(2020) 20:229.
52. Mizuno H, Ekuni D, Maruyama T, Kataoka K, Yoneda T, Fukuhara D, et al. The effects of non-surgical periodontal treatment on glycemic control, oxidative stress balance and quality of life in patients with type 2 diabetes: a randomized clinical trial. *PLoS ONE.* (2017) 12:e0188171.
53. Beaudette JR, Fritz PC, Sullivan PJ, Ward WE. Oral health, nutritional choices, and dental fear and anxiety. *Dent J.* (2017) 5:8.
54. Machado V, Botelho J, Viana J, Pereira P, Lopes LB, Proença L, et al. Association between Dietary Inflammatory Index and periodontitis: a cross-sectional and mediation analysis. *Nutrients.* (2021) 13:1194.
55. Ojo O, Ojo OO, Adebowale F, Wang XH. The effect of dietary glycaemic index on glycaemia in patients with type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. *Nutrients.* (2018)10:373.
56. Kossioni AE. The association of poor oral health parameters with malnutrition in older adults: a review considering the potential implications for cognitive impairment. *Nutrients.* (2018)10:1709.
57. Lalla RV, D'Ambrosio JA. Dental management considerations for the patient with diabetes mellitus. *J Am Dent Assoc.* 2001;132(10):1425-32.
58. Kalra S, Mukherjee JJ, Venkataraman S, Bantwal G, Shaikh S, Saboo B, et al. Hypoglycemia: the neglected complication. *Indian J Endocrinol Metab.* 2013;17(5):819-34.
59. McKenna SJ. Dental management of patients with diabetes. *Dent Clin North Am.* 2006;50(4):591-606.
60. Fernández-Real JM, López-Bermejo A, Ropero AB, PiquerS, Nadal A, Bassols J, et al. Salicylates increase insulin secretion in healthy obese subjects. *J Clin Endocrinol Metab.* 2008;93(7):2523-30.
61. World Health Organization. Global report on diabetes: World Health Organization, 2016.
62. National institute of Diabetes and Digestive and Kidney Diseases. Diabetes, Gum Disease, & Other Dental Problems, 2017.
63. Bahammam MA. Periodontal health and diabetes awareness among Saudi diabetes patients. *Patient preference and adherence.* 2015; 9:225.
64. Foryciarz K, Obrbski M, Kokoszka A. Results of the second Diabetes Attitudes, Wishes and Needs (DAWN2) study: Overview of the most important results from the Polish perspective. *Clinical Diabetology.* 2016; 5(6):185-94.
65. Javed F, Thafeed AlGhamdi AS, Mikami T, Mehmood A, Ahmed HB, Samaranayake LP, Tenenbaum HC. Effect of glycemic control on self perceived oral health, periodontal parameters, and alveolar bone loss among patients with prediabetes. *Journal of periodontology.* 2014; 85(2):234-41.

