Association Between Right Upper Molar Involvement And Diabetes Mellitus In Subjects With Chronic Periodontitis

Research Article

Gayathri R Menon[1], Sankari Malaiappan[2*], Kiran Kumar[3]

[1] Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai - 600 077, India.
[2] Professor, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai - 600 077, India.
[3] Senior Lecturer, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai - 600 077, India.

Abstract

Periodontitis is a chronic inflammatory disease characterised by destruction of supporting structures of teeth. Diabetes mellitus is a systemic disease which is characterised by increased blood glucose level and abnormalities of lipid metabolism, due to absence or decreased level of insulin. The progression of periodontal disease is influenced by factors like microorganism, host response, systemic background and genetic makeup of the host. The aim of the study was to assess the association of the right upper molar involvement between diabetes mellitus and chronic periodontitis. A retrospective data of all the patients reporting for periodontal therapy to Saveetha Dental College And Hospital was collected. The data was extracted from the patients records. Data segregation was done based on 1) age, 2) gender 3) types of periodontitis 4) blood sugar value 5) probing depth and 6) clinical attachment loss. After data collection statistical analysis was done in IBM SPSS software version 20. Chi square test was performed to determine the statistical significance. From the study 67.65% of males and 32.35 % of females with periodontitis had diabetes. The most common age group that was affected was 45-55 years by 44.12%. Patients with diabetes mostly were affected with generalised chronic periodontitis by 82.35%. Probing depth of 3mm was seen mostly in patients with diabetes and periodontitis (35.29%). Clinical attachment loss of 5mm was seen mostly in patients with diabetes and periodontitis (35.29%). Patients with periodontitis had blood sugar level above 200mg/dl by 55.88%. From the chi square test performed to determine the correlation between age of the periodontitis patients and the blood sugar levels, the P value obtained was 0.05 (p<0.05) which shows a positive significance. From the chi square test performed to determine the correlation between diabetic and periodontitis patients with clinical attachment loss showed a positive correlation with p value 0.028 (p <0.05), statistically significant. Within the limits of the present study it can be concluded that the most common age group that was affected was 45-55 years. The most common gender that is affected is male. Patients with diabetes were mostly affected with generalised chronic periodontitis.

Keywords: Diabetes Mellitus; Chronic Periodontitis; Clinical Attachment Loss; Correlation; Risk Factors.

Introduction

Chronic periodontitis is a common inflammatory disease of the supporting tissues of the teeth which is caused by specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone leading to periodontal pocket formation, gingival recession, or both [1]. Periodontitis is characterised by inflammatory changes seen in the tooth supporting tissue which is caused by bacterial infection. Periodontal diseases include two entities which are gingivitis and periodontitis. Gingivitis is a reversible inflammation of periodontal tissues whereas periodontitis also presents destruction of the tooth supporting structures, and may lead to tooth loss. Gingivitis can be caused due to bacterial plaque accumulation and is considered as the key risk factor for the onset of periodontitis. Plaque not just contains bacteria it also contains viruses which can cause disease progression [2]. The main etiologic factors of periodontal disease are microorganisms in combination with individual host susceptibility

Gayathri R Menon, Sankari Malaiappan, Kiran Kumar. Association Between Right Upper Molar Involvement And Diabetes Mellitus In Subjects With Chronic Periodontitis. *Int J Dentistry Oral Sci*. 2021;8(6):2879-2884.

2879

and environmental factors. The presence of anaerobic gram negative bacteria causes a local inflammatory response that becomes chronic and progressive: the inflammation of the gingiva causes alveolar bone destruction and clinical attachment loss to the teeth, which is caused by component of microbial plaque that have the capacity to induce an initial infiltration of inflammatory cells such as lymphocytes , macrophages and PMNs [3]. Some of the microbial components such as lipopolysaccharide, activates macrophages that will synthesise and secrete a great variety and amount of pro inflammatory molecules such as the cytokines, interleukin -1, tumor necrosis factor-alpha,prostaglandins and other enzymes [3]. Tumor necrosis factor-alpha is an important proinflammatory mediator that causes destruction of periodontal tissues [4]. Similarly recent studies have reported association between Interleukin-21 levels with periodontitis [5]. ET-1 has also been identified in periodontal diseases [6, 7]. The attachment loss deepens the sulcus creating a periodontal pocket that contains millions of bacterial cells [8, 9]. The most frequently recognised periodontal pathogens belongs to the three microphillic species (A. actinomycetemcomitans, Campylobacter rectus and Eikenella corrodens) and seven anaerobic species (porphyromonas gingivalis, bacteroides forsythus, treponema denticolla, prevotella intermedia, fusobacterium nucleatum, eubacterium and spirochetes) [10]. Periodontitis is highly prevalent and has a negative impact on quality of life [11]. Periodontitis can be associated with various systemic conditions [12]. Inorder to prevent the progression of the disease condition various periodontal therapies can be performed. Periodontal therapy primarily aims at the elimination of the disease and maintenance of a functional, healthy dentition and supporting tissue.Periodontal therapy can be non surgical,surgical and supportive periodontal therapy. A team has worked on various regenerative therapies that has been indicated for periodontitis patients [13-15] and other treatments such as coronally displaced flap and lip repositioning [16, 17]. Management of generalised chronic periodontitis patients where the esthetics and function had to be restored dental implants and implant-supported prosthesis can be a predictable treatment modality in periodontal diseases [18]. While performing surgical therapy trauma to the inferior alveolar nerve is one of the complications during surgical procedures in the posterior mandible [19]. Various antimicrobial and chemotherapeutic agents such as chlorhexidine mouth washes , triclosan are employed for the management of periodontitis [20]. Herbal medicines and preparations can also be used for the management of periodontal diseases [21].

Some variations of root anatomy in regards to the shape,size and number must be considered as predisposing factors for the appearance and evolution of periodontal disease as it is the favourable site for the bacterial plaque to accumulate [22, 23]. In multi-rooted teeth there are various clinical observations that there is a high rate of root exposure and consequently the exposure of the future area is common. In maxillary molars this fact may endanger the three existent furcation (buccal,mesial and distal) causing severe periodontal problems. It is likely that once the furcation region is affected the roots will present a greater loss of periodontal supporting structure than the other parts of the tooth. Since the plaque control is very poor and difficult in this region [24].

Diabetes mellitus is a systemic disease with several major complications affecting both quality and length of life [25]. Diabetes mellitus is a chronic metabolic disease which is characterised by hyperglycemia [26]. Hyperglycemia triggers a wide variety of long term complications in diabetes such as large vessel disease,cardiomyopathy and kidney and eye impairments [27, 28]. Both type 1 and type 2 diabetes mellitus is associated with elevated levels of systemic markers of inflammation [29]. The elevated inflammatory state in diabetes contributes to microvascular and macrovascular complications [30]. Elevated levels of IL-6 and TNF alpha have been demonstrated in diabetes [29]. From various studies it was found that there is a defect in the polymorphonuclear leukocyte activity in diabetes patients including impares chemotaxis, phagocytosis and microbial function [31]. Diabetes mellitus and periodontitis share a common platform based on pathogenesis. Previously our team has a rich experience in working on various research projects across multiple disciplines [32-46]. Hence this study aims to assess the prevalence of upper right molar involvement between diabetes mellitus and periodontitis.

Materials And Methods

This was a retrospective study in which 86000 patients were reviewed. The data extraction was from patients records , Saveetha Dental College And Hospital,Chennai. It was found that a total of 280 patients had periodontitis. After evaluating periodontal status and clinical examination of the patients, it was found that 34 patients out of the 280 patients with periodontitis had diabetes mellitus. The subjects were grouped based on the age into 4 (36-45),(46-55),(56-65),(above 65). From the data obtained it was found that 28 patients had generalised chronic periodontitis and 6 patients had localised chronic periodontitis. The blood sugar value of each of the patients were obtained and was grouped into 3; (120-150),(150-200),(Above 200). Periodontal status was diagnosed based on the probing depth and clinical attachment loss of 16. After the data collection the datas was tabulated in excel sheets and then transferred to IBM SPSS software version 20. Based on the blood sugar levels and periodontal parameters that were obtained, assessment of correlation was performed. Chi square test was the statistical test that was used to determine the correlation. Ethical consideration- the original study protocol was reviewed and approved by the research ethical committee of Saveetha Dental College And Hospital,Chennai.

Results And Discussion

In the study 67.65% of males and 32.35 % of females with periodontitis had diabetes. The most common age group that was affected was 45-55 years by 44.12%. Patients with diabetes mostly were affected with generalised chronic periodontitis by 82.35%. Probing depth of 3mm was seen mostly in patients with diabetes and periodontitis (35.29%). Clinical attachment loss of 5mm was seen in patients with diabetes and periodontitis (35.29%). Patients with periodontitis had blood sugar level above 200mg/dl by 55.88%. From the chi square test performed to determine the association between age of periodontitis patients and the blood sugar levels , the P value obtained was 0.05 (p<0.05) which shows a positive significance. From the chi square test performed to determine the association between diabetic and periodontitis patients with clinical attachment loss it shows a positive association with p value 0.028 (p <0.05), was statistically significant. The association between clinical attachment loss and blood sugar levels show a negative significance, p value obtained from chi square test was 0.570 (p>0.05).

Figure 1: Bar graph depicting the percentage distribution of age groups of diabetic patients with chronic periodontitis. X axis represents age groups and Y axis represents percentage of diabetic patients with chronic periodontitis. The age group of 36-45 years (blue) 17.65%, 46-55 years (green) 44.12% , 56-65 years (beige) 32.35%, and above 65 years (violet) 5.882%. From the figure we can infer that periodontitis with diabetes was more prevalent at the age of 46-55 years (44.12%).
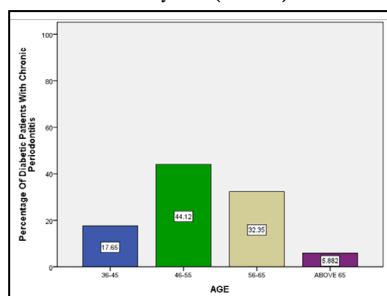

Figure 2: Bar graph depicting the percentage distribution of gender of diabetic patients with chronic periodontitis. X axis represents gender and Y axis represents percentage of diabetic patients with chronic periodontitis. 67.65% were male (blue) and the remaining 32.35% were female (green). From the figure we can infer that patients with periodontitis and diabetes were mostly male gender (67.65%).
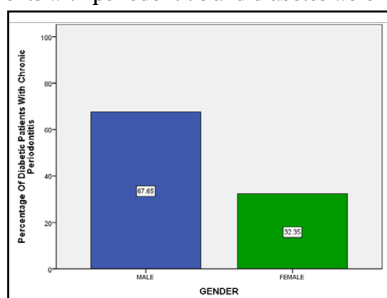

Figure 3: Bar graph depicting the percentage distribution of probing depth of upper right molar among the diabetic patients with chronic periodontitis . X axis represents probing depth from 2mm-8mm and Y axis represents percentage of diabetic patients with chronic periodontitis.Most of the periodontitis patients with diabetes had a probing depth of 3mm by 35.29% (green) and least number of patients with periodontitis and diabetes had a probing depth of 8mm by 2.941% (grey). From the figure we can infer that periodontitis patients with diabetes had a maximum probing depth of 3mm by 35.29%.
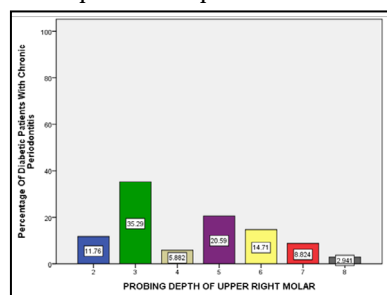

Figure 4: bar graph depicting the percentage distribution of clinical attachment loss of upper right molar among the diabetic patients with chronic periodontitis. X axis represents clinical attachment loss from 3mm -8mm and Y axis represents percentage of diabetic patients with chronic periodontitis. Majority of the periodontitis patients with diabetes had clinical attachment loss of 5mm by 35.29% (beige) and least number of periodontitis patients with diabetes had clinical attachment loss of 8mm by 2.942% (red). From the figure we can infer that periodontitis patients with diabetes had maximum clinical attachment loss of 5mm by 35.29%.
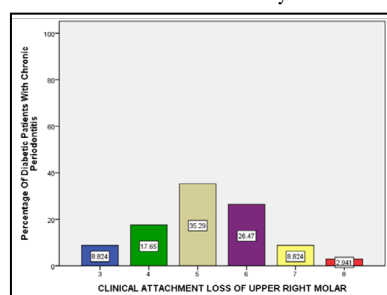
Diabetic patients with periodontitis are presented with subgingival flora which is composed mainly of capnocytophaga, anaerobic vibrios, and Actinomyces species [47]. Increased glucose level in crevicular fluid in diabetic patients may favor the growth of some of the microbial species. Impairment of neutrophil phagocytosis is observed in poorly controlled diabetics [48]. Diabetes mellitus adversely affects the host difference system and acts as a risk factor for gingivitis and periodontitis. Several altered host responses are associated with increased incidence and severity of periodontitis in diabetes patients [49].

In the study the gender that was most commonly affected with periodontitis and diabetes was males by 67.65%. In a previous study conducted, prevalence of periodontal disease was almost equal in both the gender by 59.4% in males and 59.5% in females [31]. In another study conducted with concurrent finding, it was reported that males were more commonly affected [50]. Similarly in a study conducted it was reported that males were most commonly affected than females with diabetes and periodontitis [51]. In the study the most common age group that was affected with

Gayathri R Menon, Sankari Malaiappan, Kiran Kumar. Association Between Right Upper Molar Involvement And Diabetes Mellitus In Subjects With Chronic Periodontitis. *Int J Dentistry Oral Sci*. 2021;8(6):2879-2884.

Figure 5: bar graph depicting the percentage distribution of type of periodontitis among diabetic patients. X axis represents type of periodontitis and Y axis represents percentage of diabetic patients with chronic periodontitis. 82.35% of patients with diabetes had generalised chronic periodontitis (blue) and 17.65% of patients with diabetes had localised chronic periodontitis (green). From the graph we can infer that most of the diabetic patients had generalised chronic periodontitis by 82.35%.
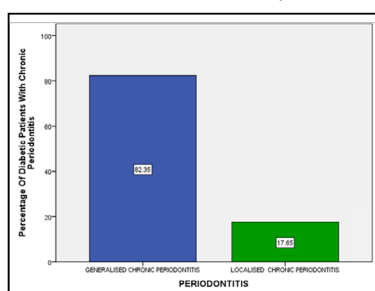

Figure 6: Bar graph depicting the percentage distribution of blood sugar level among periodontitis patients with diabetes. X axis represents blood sugar values and Y axis represents percentage of diabetic patients with chronic periodontitis. Majority of the periodontitis patients had blood sugar levels of above 200mg/dl by 55.88% (beige) and least number of patients with periodontitis had a blood sugar level of 120-150 mg/dl by 20.59% (blue). From the graph we can infer that most of the periodontitis patients had blood sugar levels above 200 mg/ dl (55.88%).
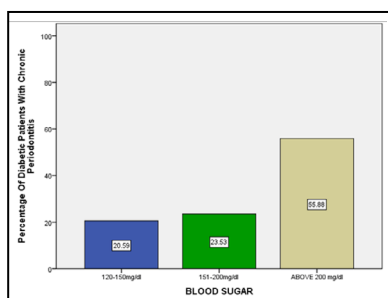

Figure 7: Bar graph depicts the percentage association between age and blood sugar levels of diabetic patients with chronic periodontitis. X axis represents age groups of the patients and Y axis represents the percentage of diabetic patients with chronic periodontitis. Blood sugar values of 120-150 mg/dl (blue), 151-200 mg/dl (green) and above 200 mg/dl (beige). Chi square test shows the p value 0.05 (p value <0.05) statistically significant. From the figure we can infer that periodontitis patients at the age of 56-65 years had blood sugar level 200mg/dl maximum (26.47%).
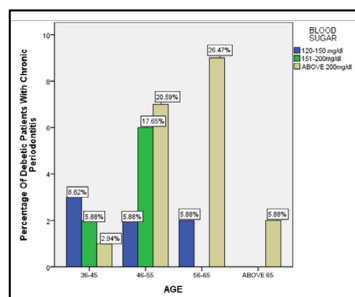

Figure 8: Bar graph depicts the association between age and clinical attachment loss of diabetic patients with chronic periodontitis. X axis represents age groups of the patients and Y axis represents the percentage of diabetic patients with chronic periodontitis. Clinical attachment loss of 3mm (blue), 4mm (green), 5mm (beige), 6mm (violet) , 7mm(yellow) and 8mm (red) .Chi square test shows the p value 0.028 (p value <0.05) statistically significant. From the graph we can infer that periodontitis patients with diabetes had a maximum clinical attachment loss of 5mm at the age of 46-55 years by 17.65%.
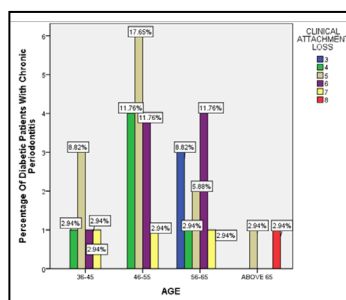

periodontitis and diabetes was 45-55 years. In a previous study it was found that the most common age group that was affected with periodontitis and diabetes was above 55years [31]. In yet another study conducted it was reported that the most common age group that was affected was 41-64 years by 53.1% [52]. In a previous study conducted it was found that the most common age group that was affected was 36-45 years [53]. In the present study, chi square test performed to determine the correlation between age of the periodontitis patients and the blood sugar levels,

the P value obtained was 0.05 (p<0.05) which shows a positive significance. In a study which was conducted Neelima S Rajhans et al., it was found that there is a prevalence of periodontitis in diabetic patients by 86% [31]. In another study conducted it was reported that there is a significance in the prevalence of diabetes in periodontitis patients with p value=0.000 [50]. In the present study, the chi square test performed to determine the correlation between diabetic and periodontitis patients with clinical attachment loss of upper right molar shows a positive correlation with p

Gayathri R Menon, Sankari Malaiappan, Kiran Kumar. *Association Between Right Upper Molar Involvement And Diabetes Mellitus In Subjects With Chronic Periodontitis. Int J Dentistry Oral Sci*. 2021;8(6):2879-2884.

Figure 9: Bar graph depicts the association between blood sugar levels and clinical attachment loss of diabetic patients with chronic periodontitis. X axis represents clinical attachment loss and Y axis represents the percentage of diabetic patients with chronic periodontitis. Blood sugar level of 120-150 mg/dl (blue), 151-200mg/dl (green), above 200 mg/dl (beige).Chi square test shows the p value 0.570 (p value >0.05) statistically not significant. From the graph we can infer that periodontitis patients with diabetes had a maximum clinical attachment loss of 5mm when the blood sugar level was above 200 mg/dl, however it was statistically not significant (p value 0.570).
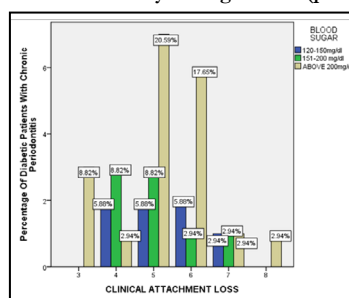
value 0.028 (p <0.05), statistically significant. In a previous study they have reported that there is a significant correlation between diabetes and molar type in periodontitis with p value <0.05 [54]. In another study it was reported that subjects with type 2 diabetes have an increased risk of destructive periodontitis with an odds ratio of 2.81 when clinical attachment loss is used to measure the disease [55]. Our institution is passionate about high quality evidence based research and has excelled in various fields [56-66].

The limitation of the study is the limited sample size and it does not include the ethinic group. It is a single centered study. The future scope of the study is that a prospective study can be performed with a larger population.

Conclusion

Based on present study the most prevalent age group was 45-55 years. The most common gender affected are male. Majority of diabetes subjects had generalised chronic periodontitis than localised periodontitis . Although an association between age and blood sugar levels was established. An association between clinical attachment loss and blood sugar level was not significant but further prospective study is required to assess the involvement of upper right molar with periodontitis, whether age was the causative factor for chronic periodontitis or blood sugar levels.

Authors Contribution

Gayathri R Menon , Dr Shankari Malaiappan were the main contributors to the concept, design, literature analysis, workshop discussions, and drafting and revising manuscript. Dr Shankari Malaiappan and Dr Kiran Kumar contributed to drafting and revising manuscripts. All authors gave final approval of the version to be published.

Acknowledgment

References

[1].   Negrato CA, Tarzia O. Buccal alterations in diabetes mellitus. Diabetol Metab Syndr. 2010 Dec;2(1):1-1.
[2].   Priyanka S, Kaarthikeyan G, Nadathur JD, Mohanraj A, Kavarthapu A. Detection of cytomegalovirus, Epstein-Barr virus, and Torque Teno virus in subgingival and atheromatous plaques of cardiac patients with chronic periodontitis. J Indian Soc Periodontol. 2017 Nov-Dec;21(6):456-460.Pubmed

PMID: 29551863.
[3].   Sorsa T, Ingman T, Suomalainen K, Haapasalo MT, Konttinen YT, Lindy O, et al. Identification of proteases from periodontopathogenic bacteria as activators of latent human neutrophil and fibroblast-type interstitial collagenases. Infect. Immun. 1992 Nov;60(11):4491-5.
[4].   Varghese SS, Thomas H, Jayakumar ND, Sankari M, Lakshmanan R. Estimation of salivary tumor necrosis factor-alpha in chronic and aggressive periodontitis patients. Contemp Clin Dent. 2015 Sep;6(Suppl 1):S152-6. Pubmed PMID: 26604566.
[5].   Mootha A, Malaiappan S, Jayakumar ND, Varghese SS, Toby Thomas J. The Effect of Periodontitis on Expression of Interleukin-21: A Systematic Review. Int J Inflam. 2016;2016:3507503.Pubmed PMID: 26998377.
[6].   Khalid W, Vargheese SS, Lakshmanan R, Sankari M, Jayakumar ND. Role of endothelin-1 in periodontal diseases: A structured review. Indian J Dent Res. 2016 May-Jun;27(3):323-33.Pubmed PMID: 27411664.
[7].   Khalid W, Varghese SS, Sankari M, Jayakumar ND. Comparison of Serum Levels of Endothelin-1 in Chronic Periodontitis Patients Before and After Treatment. J Clin Diagn Res. 2017 Apr;11(4):ZC78-ZC81.Pubmed PMID: 28571268.
[8].   Geerts SO, Legrand V, Charpentier J, Albert A, Rompen EH. Further evidence of the association between periodontal conditions and coronary artery disease. J. Periodontol. 2004 Sep;75(9):1274-80.
[9].   Kornman KS, Page RC, Tonetti MS. The host response to the microbial challenge in periodontitis: assembling the players. Periodontol 2000. 1997 Jun;14:33-53.Pubmed PMID: 9567965.
[10]. Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent Jr RL. Microbial complexes in subgingival plaque. J. Periodontol.. 1998 Feb;25(2):134-44.
[11]. O'Dowd LK, Durham J, McCracken GI, Preshaw PM. Patients' experiences of the impact of periodontal disease. J Clin Periodontol. 2010 Apr;37(4):334-9.
[12]. Ramesh A, Varghese SS, Jayakumar ND, Malaiappan S. Chronic obstructive pulmonary disease and periodontitis–unwinding their linking mechanisms. J Oral Biosci. 2016 Feb 1;58(1):23-6.
[13]. Ravi S, Malaiappan S, Varghese S, Jayakumar ND, Prakasam G. Additive Effect of Plasma Rich in Growth Factors With Guided Tissue Regeneration in Treatment of Intrabony Defects in Patients With Chronic Periodontitis: A Split-Mouth Randomized Controlled Clinical Trial. J Periodontol. 2017 Sep;88(9):839-845.Pubmed PMID: 28474968.
[14]. Panda S, Jayakumar ND, Sankari M, Varghese SS, Kumar DS. Platelet rich fibrin and xenograft in treatment of intrabony defect. Contemp. Clin. Dent. 2014 Oct;5(4):550-4.
[15]. Avinash K, Malaippan S, Dooraiswamy JN. Methods of Isolation and Characterization of Stem Cells from Different Regions of Oral Cavity Using Markers: A Systematic Review. Int J Stem Cells. 2017 May 30;10(1):12-20. Pubmed PMID: 28531913.
[16]. Thamaraiselvan M, Elavarasu S, Thangakumaran S, Gadagi JS, Arthie T. Comparative clinical evaluation of coronally advanced flap with or without platelet rich fibrin membrane in the treatment of isolated gingival recession. J Indian Soc Periodontol. 2015 Jan;19(1):66-71.
[17]. Ramesh A, Vellayappan R, Ravi S, Gurumoorthy K. Esthetic lip repositioning: A cosmetic approach for correction of gummy smile - A case series. J Indian Soc Periodontol. 2019 May-Jun;23(3):290-294.Pubmed PMID: 31143013.
[18]. Ramesh A, Ravi S, Kaarthikeyan G. Comprehensive rehabilitation using dental implants in generalized aggressive periodontitis. J. Indian Soc. Periodontol.. 2017 Mar;21(2):160-3.
[19]. Kavarthapu A, Thamaraiselvan M. Assessing the variation in course and position of inferior alveolar nerve among south Indian population: A cone beam computed tomographic study. Indian J Dent Res. 2018 Jul-

Gayathri R Menon, Sankari Malaiappan, Kiran Kumar. Association Between Right Upper Molar Involvement And Diabetes Mellitus In Subjects With Chronic Periodontitis. *Int J Dentistry Oral Sci*. 2021;8(6):2879-2884.

2883

Aug;29(4):405-409.Pubmed PMID: 30127186.

[20]. Ramamurthy JA, Mg V. Comparison of effect of hiora mouthwash versus chlorhexidine mouthwash in gingivitis patients: a clinical trial. Asian J Pharm Clin Res. 2018;11(7):84.

[21]. Ramesh A, Varghese SS, Doraiswamy JN, Malaiappan S. Herbs as an antioxidant arsenal for periodontal diseases. J Intercult Ethnopharmacol. 2016 Jan 27;5(1):92-6.Pubmed PMID: 27069730.

[22]. Hou GL, Tsai CC. Cervical enamel projection and intermediate bifurcational ridge correlated with molar furcation involvements. J Periodontol. 1997 Jul;68(7):687-93.Pubmed PMID: 9249641.

[23]. Mandelaris GA, Wang HL, MacNeil RL. A morphometric analysis of the furcation region of mandibular molars. Compend Contin Educ Dent (Jamesburg, NJ: 1995). 1998 Feb 1;19(2):113-6.

[24]. Wærhaug J. The furcation problem: Etiology, pathogenesis, diagnosis, therapy and prognosis. J. Clin. Periodontol. 1980 Apr;7(2):73-95.

[25]. Iacopino AM. Periodontitis and diabetes interrelationships: role of inflammation. Ann Periodontol. 2001 Dec;6(1):125-37.Pubmed PMID: 11887455.

[26]. Awuti G, Younusi K, Li L, Upur H, Ren J. Epidemiological survey on the prevalence of periodontitis and diabetes mellitus in Uyghur adults from rural Hotan area in Xinjiang. Exp Diabetes Res. 2012;1-8.Pubmed PMID: 21826136.

[27]. Cerbone AM, Macarone-Palmieri N, Saldalamacchia G, Coppola A, Di Minno G, Rivellese AA. Diabetes, vascular complications and antiplatelet therapy: open problems. Acta Diabetol. 2009 Dec;46(4):253-61.

[28]. Ren J, Ceylan-Isik AF. Diabetic cardiomyopathy. Endocrine. 2004 Nov;25(2):73-83.

[29]. Dandona P, Aljada A, Bandyopadhyay A. Inflammation: the link between insulin resistance, obesity and diabetes. Trends Immunol. 2004 Jan 1;25(1):4-7.

[30]. Brownlee M. The pathobiology of diabetic complications: a unifying mechanism. diabetes. 2005 Jun 1;54(6):1615-25.

[31]. Rajhans NS, Kohad RM, Chaudhari VG, Mhaske NH. A clinical study of the relationship between diabetes mellitus and periodontal disease. J Indian Soc Periodontol. 2011 Oct;15(4):388.

[32]. Hafeez N. Accessory foramen in the middle cranial fossa. Res J Pharm Technol. 2016 Nov 1;9(11):1880.

[33]. Krishnan RP, Ramani P, Sherlin HJ, Sukumaran G, Ramasubramanian A, Jayaraj G, et al. Surgical Specimen Handover from Operation Theater to Laboratory: A Survey. Ann Maxillofac Surg. 2018 Jul-Dec;8(2):234-238. Puubmed PMID: 30693238.

[34]. Somasundaram S, Ravi K, Rajapandian K, Gurunathan D. Fluoride Content of Bottled Drinking Water in Chennai, Tamilnadu. J Clin Diagn Res. 2015 Oct;9(10):ZC32-4.Pubmed PMID: 26557612.

[35]. Felicita AS. Orthodontic extrusion of Ellis Class VIII fracture of maxillary lateral incisor - The sling shot method. Saudi Dent J. 2018 Jul;30(3):265-269.Pubmed PMID: 29942113.

[36]. Kumar S, Rahman RE. Knowledge, awareness, and practices regarding biomedical waste management among undergraduate dental students. Asian J. Pharm. Clin. Res. 2017;10(8):341.

[37]. Gurunathan D, Shanmugaavel AK. Dental neglect among children in Chennai. J Indian Soc Pedod Prev Dent. 2016 Oct 1;34(4):364.

[38]. Sneha S. Knowledge and awareness regarding antibiotic prophylaxis for infective endocarditis among undergraduate dental students. Asian J. Pharm. Clin. Res. 2016 Oct 1:154-9.

[39]. Dhinesh B, Lalvani JI, Parthasarathy M, Annamalai K. An assessment on performance, emission and combustion characteristics of single cylinder diesel engine powered by Cymbopogon flexuosus biofuel. Energy Convers. Manag. 2016 Jun 1;117:466-74.

[40]. Choudhari S, Thenmozhi MS. Occurrence and Importance of Posterior Condylar Foramen. LATERALITY. 2016 Aug 28;8:11-43.

[41]. Paramasivam A, Vijayashree Priyadharsini J, Raghunandhakumar S. N6-adenosine methylation (m6A): a promising new molecular target in hypertension and cardiovascular diseases. Hypertens Res. 2020 Feb;43(2):153-154.Pubmed PMID: 31578458.

[42]. Wu F, Zhu J, Li G, Wang J, Veeraraghavan VP, Krishna Mohan S, et al. Biologically synthesized green gold nanoparticles from Siberian ginseng induce growth-inhibitory effect on melanoma cells (B16). Artif Cells Nanomed Biotechnol. 2019 Dec;47(1):3297-3305.Pubmed PMID: 31379212.

[43]. Palati S, Ramani P, Shrelin HJ, Sukumaran G, Ramasubramanian A, Don KR, et al. Knowledge, Attitude and practice survey on the perspective of oral lesions and dental health in geriatric patients residing in old age homes. Indian J Dent Res. 2020 Jan-Feb;31(1):22-25.Pubmed PMID: 32246676.

[44]. Saravanan M, Arokiyaraj S, Lakshmi T, Pugazhendhi A. Synthesis of silver nanoparticles from Phenerochaete chrysosporium (MTCC-787) and their antibacterial activity against human pathogenic bacteria. Microb Pathog. 2018 Apr;117:68-72.Pubmed PMID: 29427709.

[45]. Govindaraju L, Gurunathan D. Effectiveness of Chewable Tooth Brush

[46]. Vijayakumar Jain S, Muthusekhar MR, Baig MF, Senthilnathan P, Loganathan S, Abdul Wahab PU et al. Evaluation of Three-Dimensional Changes in Pharyngeal Airway Following Isolated Lefort One Osteotomy for the Correction of Vertical Maxillary Excess: A Prospective Study. J Maxillofac Oral Surg. 2019 Mar;18(1):139-146.Pubmed PMID: 30728705.

[47]. Miller LS, Manwell MA, Newbold D, Reding ME, Rasheed A, Blodgett J,et al. The relationship between reduction in periodontal inflammation and diabetes control: a report of 9 cases. J Periodontol. 1992 Oct;63(10):843-8. Pubmed PMID: 1403592.

[48]. Oliver RC, Tervonen T, Flynn DG, Keenan KM. Enzyme activity in crevicular fluid in relation to metabolic control of diabetes and other periodontal risk factors. J Periodontol. 1993 May;64(5):358-62.Pubmed PMID: 8390572.

[49]. Llambés F, Arias-Herrera S, Caffesse R. Relationship between diabetes and periodontal infection. World J Diabetes. 2015 Jul 10;6(7):927-35.

[50]. Apoorva SM, Sridhar N, Suchetha A. Prevalence and severity of periodontal disease in type 2 diabetes mellitus (non-insulin-dependent diabetes mellitus) patients in Bangalore city: An epidemiological study. J Indian Soc Periodontol. 2013 Jan;17(1):25-9.Pubmed PMID: 23633768.

[51]. Nand K, Oommen A, Chacko R, Abraham V. Chronic periodontitis among diabetics and nondiabetics aged 35–65 years, in a rural block in Vellore, Tamil Nadu: A cross-sectional study. J Indian Soc Periodontol. 2018.

[52]. Ojehanon PI, Azodo CC, Erhabor P, Orhue V. Periodontal characteristics of diabetic patients with tooth mobility. JOSH-Diabetes. 2017 Dec;5(02):094-9.

[53]. Singh P, Kaur M, Singh I. Association of systemic and periodontal diseases: A hospital based study.2017.

[54]. Gopalakrishnan D, Miller PD, Mahuli AV, Sangamithra S, Phantumvanit P, Buranawat B. Evaluation of periodontally diseased molars in diabetics with Miller-McEntire Periodontal Prognostic Index. J Indian Soc Periodontol. 2018 Sep-Oct;22(5):401-405.Pubmed PMID: 30210188.

[55]. Emrich LJ, Shlossman M, Genco RJ. Periodontal disease in non-insulin-dependent diabetes mellitus. J Periodontol. 1991 Feb;62(2):123-31.

[56]. Vijayashree Priyadharsini J. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019 Dec;90(12):1441-1448.Pubmed PMID: 31257588.

[57]. PC J, Marimuthu T, Devadoss P, Kumar SM. Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study. Clin Implant Dent Relat Res. 2018 Apr 6;20(4):531-4.

[58]. Ramesh A, Varghese S, Jayakumar ND, Malaiappan S. Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study. J Periodontol. 2018 Oct;89(10):1241-1248.Pubmed PMID: 30044495.

[59]. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJ. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. Clin Oral Investig. 2019 Sep;23(9):3543-50.

[60]. Sridharan G, Ramani P, Patankar S, Vijayaraghavan R. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. J. Oral Pathol. Med. 2019 Apr;48(4):299-306.

[61]. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019 Feb;48(2):115-121.Pubmed PMID: 30451321.

[62]. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial. Clin Oral Investig. 2020 Sep;24(9):1-6.Pubmed PMID: 31955271.

[63]. Samuel SR. Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life? Int J Paediatr Dent. 2021 Mar;31(2):285-286.Pubmed PMID: 32416620.

[64]. R H, Ramani P, Ramanathan A, R JM, S G, Ramasubramanian A, et al. CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene. Oral Surg Oral Med Oral Pathol Oral Radiol. 2020 Sep;130(3):306-312.Pubmed PMID: 32773350.

[65]. Chandrasekar R, Chandrasekhar S, Sundari KKS, Ravi P. Development and validation of a formula for objective assessment of cervical vertebral bone age. Prog Orthod. 2020 Oct 12;21(1):38.Pubmed PMID: 33043408.

[66]. Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen A. baumannii and related species. Arch Oral Biol. 2018 Oct;94:93-98.Pubmed PMID: 30015217.

Gayathri R Menon, Sankari Malaiappan, Kiran Kumar. Association Between Right Upper Molar Involvement And Diabetes Mellitus In Subjects With Chronic Periodontitis. *Int J Dentistry Oral Sci*. 2021;8(6):2879-2884.

2884