Association Of Hemoglobin Levels Among Patients with Gingivitis, Chronic & Aggressive Periodontitis - A Retrospective Study

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Abstract

Back Ground : Periodontitis is defined as the inflammation of the supporting tissue of teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of PDL & alveolar bone with increased probing depth formation, recession or both. Anaemia of chronic disease is defined as anemia occurring in chronic infections, inflammatory conditions, or neoplastic disorders which are not due to marrow deficiencies/ other diseases, & occurring despite the presence of adequate iron stores & vitamins.

Aim : The aim of the study is to analyse the association of Hemoglobin(Hb) levels among patients with Gingivitis, Chronic & Aggressive Periodontitis.

Materials And Methods : This retrospective cross-sectional study was carried out in a private dental institute which included patient's details like Patients age, Name, Gender, periodontal status, Hb report were collected from June 2019 to March 2021. The inclusion criteria were : Patient's name, age, gender , PID and Patient's periodontal status, Hemoglobin level. After applying inclusion criteria, a random data of 30-Generalised chronic gingivitis patients, 30-Generalised chronic periodontitis, 30-Generalised aggressive periodontitis were collected. Datas were collected in an online forum Digital Information Archiving System and entered in Ms Excel sheet. Variables were defined and managed by entering datas to SPSS. Chi square tests and ANOVA were employed to find the association between different variables.

Results: Most of the healthy patients and patients with periodontal disease commonly have Hb levels of 12-15gm/dl (53%-Healthy, 40%-Gingivitis, 73%-Chronic periodontitis, 67%-Aggressive periodontitis). All the healthy and gingivitis patients had Periodontal probing depth of 1-3mm, Major of the chronic periodontitis patients(50%) have Periodontal probing depth of >8mm and aggressive periodontitis patients (57%) have Periodontal probing depth of 57%. All the healthy and gingivitis patients have no Clinical attachment loss, 77% of the chronic periodontitis patients have Clinical attachment loss of >5mm and all the aggressive periodontitis patients have Clinical attachment loss of >5mm. The mean Hemoglobin of Generalised chronic gingivitis patients was found to be 13.36%, Generalised chronic periodontitis was found to be 13.7mg/dl and Generalised aggressive periodontitis was found to be 13.04mg/dl. On comparing, Generalised chronic gingivitis with Generalised chronic periodontitis P=0.183 and Generalised chronic gingivitis with Generalised aggressive periodontitis P=0.127. Hence, there is no significant association between Generalised chronic gingivitis with Generalised chronic periodontitis and Generalised aggressive periodontitis (P>0.05).

Conclusion: The treatment of periodontitis can lead to an improvement in hematocrit and other related blood parameters in chronic generalized periodontitis patients with anemia. This provides evidence that periodontitis like other chronic diseases may also cause anemia.

Keywords: Anemia, Inflammation, Hemoglobin ,Periodontal disease, periodontal pocket

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INTRODUCTION

Periodontitis is a group of common chronic infections affecting the supporting tissues of the teeth which are initiated by the periodontopathogenic microorganisms residing in the dental plaque [1][2],[3]. It is an inflammatory reaction in the periodontal tissues that interacts between the pathogenic microorganisms and the host inflammatory cells resulting in tissue destruction [4–6]. Tissue destruction is confined to the periodontal tissues, the bacterial products or the microorganisms that invade the periodontal tissues through the ulcerated pocket epithelium and gain access to the systemic circulation [7]. The release of microorganisms from the lesion into the systemic circulation can activate the immune system and initiate a systemic acute-phase response. Much research has indicated a strong relationship between periodontal disease and systemic conditions such as diabetes mellitus[8], cardiovascular diseases [9,10], and it is suggested that the activation of the systemic immune response in periodontal diseases may be the link between these diseases and systemic health.

Anemia, defined as a decrease in the number of red blood cells or in the hemoglobin concentration that results in a reduction in the oxygen-carrying capacity of blood. It is a major public health problem affecting both developing and developed countries [11,12]. It is an indicator of poor nutrition and poor health, significantly affects human health as well as social and economic development, an important contributing factor to the global burden of diseases [12]. The most common etiology is iron deficiency, others causes are blood loss, chronic infections, inflammatory conditions and micronutrient deficiencies.

Periodontitis patients have an altered blood cell count compared with periodontally healthy controls [13–15]. A large number of studies have demonstrated an increased leukocyte count among periodontitis patients, and a few studies have shown a link between periodontal diseases and decreased erythrocyte counts [16–18]. Hence, periodontal diseases may be associated with anemia of chronic disease. The majority of studies investigating the systemic effects of periodontal diseases have been conducted among patients with chronic periodontitis, and only a few have focused on the effects of aggressive periodontitis on hematological variables. Previous studies demonstrated that patients with generalized aggressive periodontitis had increased leukocyte counts compared with healthy controls [19]. However, there is very little data regarding the Association of Hb levels among patients with Gingivitis, Chronic & Aggressive Periodontitis.Our team has extensive knowledge and research experience that has translated into high quality publications.[20–32],[33–37][38][39]. Hence, the present study was conducted to determine the association of Hb levels among patients with Gingivitis, Chronic & Aggressive Periodontitis.

Materials And Methods

This retrospective cross-sectional study was carried out in a private dental institute which included patient's details like Patients age, Name, Gender, periodontal status, Hb report were collected from June 2019 to March 2021. The inclusion criteria were : Patient's name, age, gender , PID and Patient's periodontal status, Hemoglobin level. Datas were collected in an online forum DIAS and entered in Ms Excel sheet. After applying inclusion criteria, a random data of 30-Generalised chronic gingivitis patients, 30-Generalised chronic periodontitis, 30-Generalised aggressive periodontitis were collected.Patient's periodontal status were cross verified for classifying patients under Generalised chronic gingivitis, Generalised chronic periodontitis, Generalised aggressive periodontitis. Variables were defined and managed by entering datas to SPSS. Bar chart was drawn for finding the association of Hb level among Healthy patients. Datas were entered in MS Excel spreadsheet. The data from the Excel spreadsheet was transferred to SPSS software version 23.0 for analysis. Chi square tests were employed to find the association between different variables.

Eligibility criteria

Patients visiting a dental college who has taken Hb test

Inclusion criteria

Patient's age, gender, Patient's periodontal status and Hemoglobin level.

Statistical analysis

All the obtained data was entered on Microsoft Excel sheet and analyzed using Statistical Package for Social Science (SPSS, IBM, USA) version 20. These results were analysed by 2 way ANOVA classification.

Results

Total of 90 patients were selected randomly. Of which 30 patients with Generalised chronic gingivitis, 30 - Generalised chronic periodontitis, 30 - Aggressive periodontitis. Most of the healthy patients and patients with periodontal disease commonly have Hb levels of 12-14gm/dl (43.33%-Healthy, 43.33%-Gingivitis, 60%-Chronic periodontitis, 66.7%-Aggressive periodontitis). All the healthy and gingivitis patients had PPD of 1-3mm, Majority of the chronic periodontitis patients(50%) have PPD of >8mm and aggressive periodontitis patients (57%) have PPD of 57%. All the healthy and gingivitis patients have no CAL, 77% of the chronic periodontitis patients have CAL of >5mm and all the aggressive periodontitis patients have CAL of >5mm.

Discussion

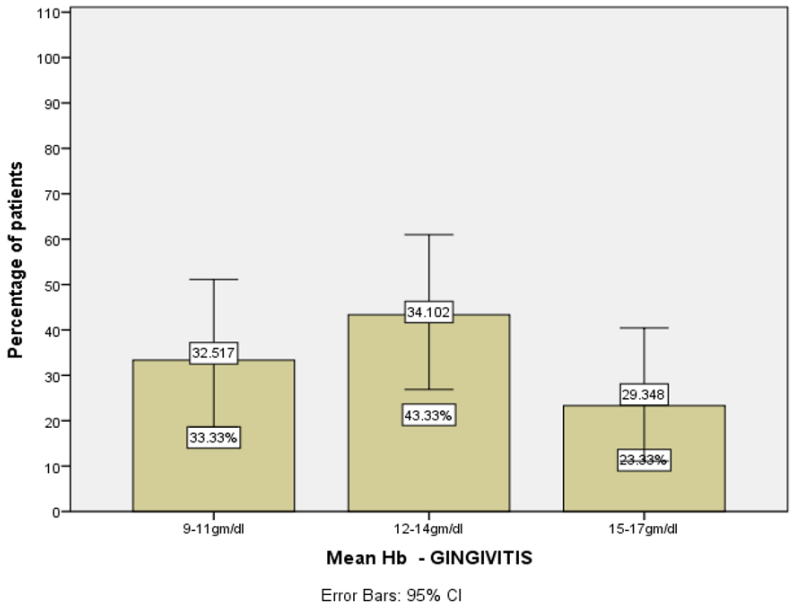

Figure 1: shows the bar graph of distribution of Mean Hemoglobin among patients with Gingivitis. The Mean Hb of the patients with Gingivitis were mentioned in X-axis which were categorized as 9-11mg/dl, 12-14mg/dl and 15-17mg/dl and the percentage of patients with Gingivitis were mentioned in Y-axis. Of these, patients with Gingivitis of Hb level 12-14mg/dl seemed to be at a higher rate (43.33%) than 15-17mg/dl(33.33%) and 9-11mg/dl(23.33%).

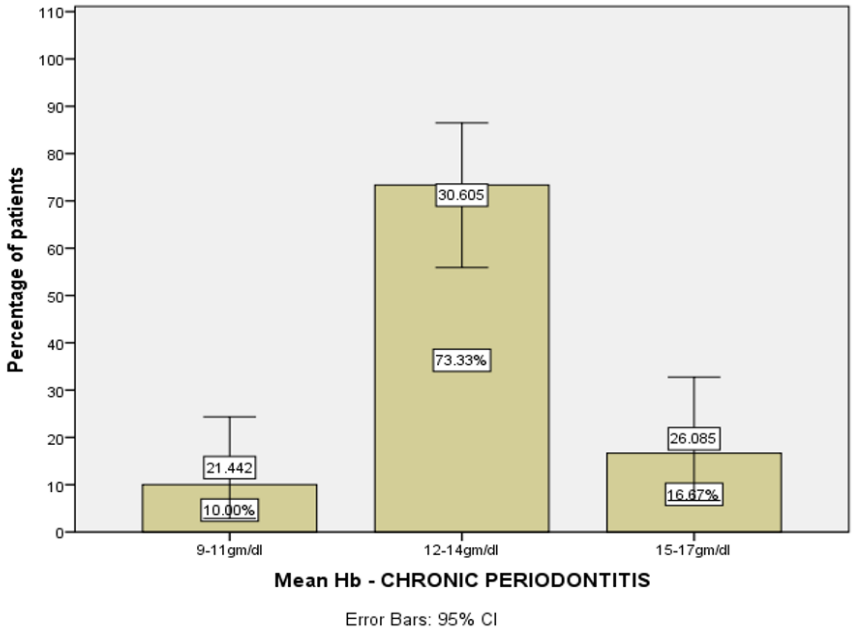

Figure 2: shows the bar graph of distribution of Mean Hemoglobin among patients with Chronic periodontitis. The Mean Hb of the patients with Chronic periodontitis were mentioned in X-axis which were categorized as 9-11mg/dl, 12-14mg/dl and 15-17mg/dl and the percentage of patients with Chronic periodontitis were mentioned in Y-axis. Of these, patients with Chronic periodontitis of Hb level 12-14mg/dl seemed to be at a higher rate (60%) than 15-17mg/dl(36.67%) and 9-11mg/dl(3.33%).

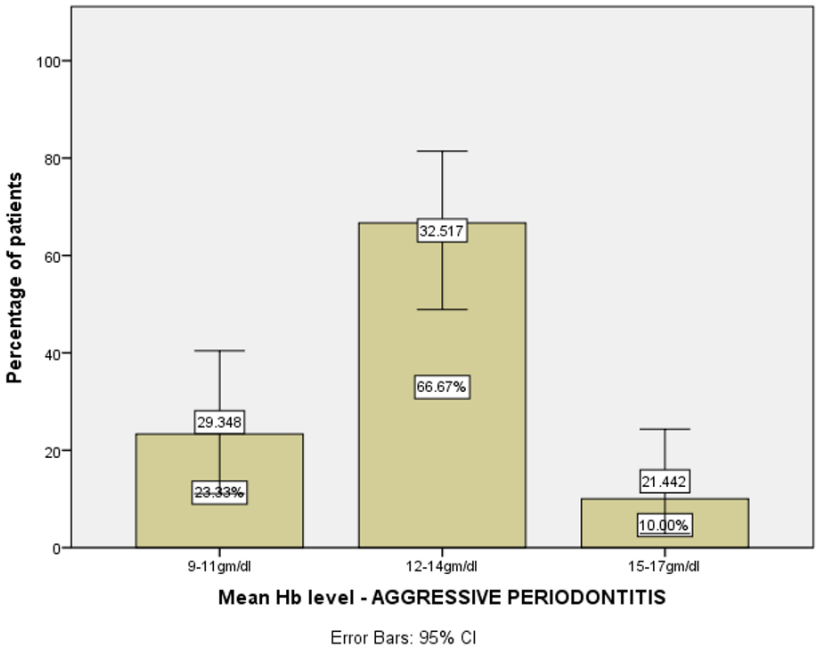

Figure 3: shows the bar graph of distribution of Mean Hemoglobin among patients with Aggressive periodontitis. The Mean Hb of the patients with Aggressive periodontitis were mentioned in X-axis which were categorized as 9-11mg/dl, 12-14mg/dl and 15-17mg/dl and the percentage of patients with Aggressive periodontitis were mentioned in Y-axis. Of these, patients with Aggressive periodontitis of Hb level 12-14mg/dl seemed to be at a higher rate (66.67%) than 15-17mg/dl(20%) and 9-11mg/dl(13.33%).

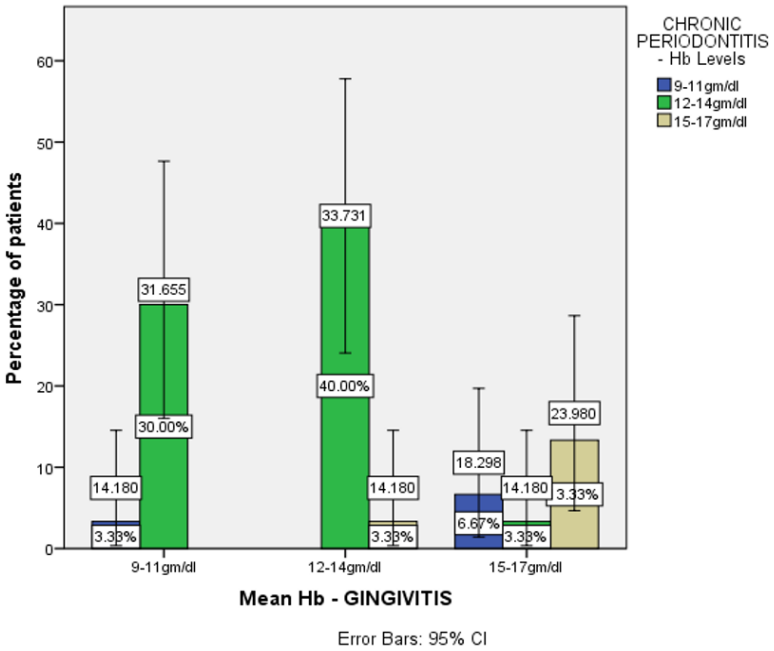

Figure 4: shows the bar graph representing the association between Mean Hb among patients with Gingivitis and Mean Hb among patients with Generalised chronic periodontitis where X-axis represents the Mean Hb among patients with Gingivitis association with Mean Hb among patients with Generalised chronic periodontitis and Y-axis represents the Count of patients received who got their Hb test report. 30% of Generalised chronic gingivitis and Generalised chronic periodontitis patients had a mean hemoglobin level of 12-14mg/dl which was at a higher rate. p-value > 0.05 (Chi-square value - 3.737a; P-value : 0.443). Hence, it is statistically insignificant.

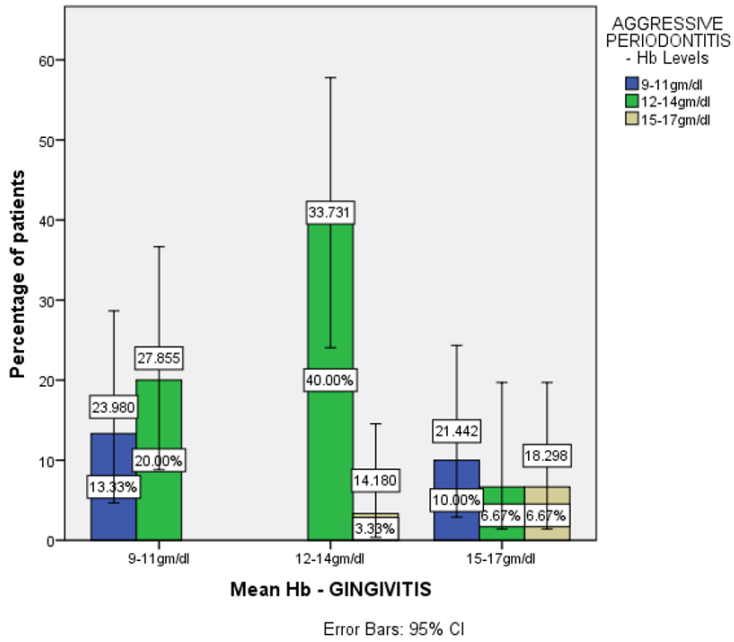

Figure 5: shows the bar graph representing the association between Mean Hb among patients with Generalised chronic periodontitis and Mean Hb among patients with Generalised aggressive periodontitis where X-axis represents the Mean Hb among patients with Generalised chronic periodontitis association with Mean Hb among patients with Generalised aggressive periodontitis and Y-axis represents the Count of patients received who got their Hb test report. 36.67% of Generalised chronic periodontitis and Generalised aggressive periodontitis patients had a mean hemoglobin level of 12-14mg/dl which was at a higher rate. p-value > 0.05 (Chi-square value - 10.609aa; P-value : 0.031). Hence, it is statistically insignificant.

ANOVA		
		Sig.
Generalised Chronic Periodontitis	Between Groups	.183
	Within Groups	
	Total	
Generalised Aggressive Periodontitis	Between Groups	.127
	Within Groups	

One Way Anova

Mean		
Generalised Chronic Gingivitis	Generalised Chronic Periodontitis	Generalised Aggressive Periodontitis
13.36mg/Dl	13.7mg/Dl	13.04mg/Dl

The mean Hemoglobin of Generalised chronic gingivitis patients was found to be 13.36%, Generalised chronic periodontitis was found to be 13.7mg/dl and Generalised aggressive periodontitis was found to be 13.04mg/dl. After comparing the mean values of Generalised chronic gingivitis with Generalised chronic periodontitis and Generalised chronic gingivitis with Generalised aggressive periodontitis the P-value was found to be >0.05. Hence, no significant association was found between Generalised chronic gingivitis with Generalised chronic periodontitis and Generalised aggressive periodontitis. On comparing, Generalised chronic gingivitis with Generalised chronic periodontitis P=0.183 and Generalised chronic gingivitis with Generalised aggressive periodontitis P=0.127. Hence, there is no significant association between Generalised chronic gingivitis with Generalised chronic periodontitis and Generalised aggressive periodontitis (P>0.05).

All the healthy and gingivitis patients have no CAL, 77% of the chronic periodontitis patients have CAL of >5mm and all the aggressive periodontitis patients have CAL of >5mm. Nubesh et al., , Gayathri et al.,[40] supported our study stating there was mild/no association of Hb levels with Periodontal disease. The results of that study showed that decrease in Hb and erythrocyte counts and increase in white blood corpuscles counts in chronic generalized periodontitis when compared to healthy controls and chronic generalized gingivitis group. There was no statistically significant difference in MCV, MCH, MCHC, and ESR among the groups.

Most of the healthy patients and patients with periodontal disease commonly have Hb levels of 12-15gm/dl (43.33%-Healthy, 43.33%-Gingivitis, 60%-Chronic periodontitis, 66.7%-Aggressive periodontitis). Mahajan et al.,[41]in his study obtained results that Dimorphic anemia and mental depression were possible systemic manifestations of Generalised aggressive periodontitis.

Donglei Wu et al.,[42] reported in his study that periodontitis decreases Hb concentration and disturbs the balance of iron metabolism, which confirms the strength of association between periodontitis and the development tendency of Anaemia of Inflammation , especially for severe periodontitis.

Patel et a.,2014 [43] in their study found a correlation between chronic periodontitis and decreased levels of Hb, hematocrit value, and RBC count, suggesting that anemia is induced by inflammation caused in patients suffering from periodontal disease and also gave a note that non-surgical periodontal therapy could improve the anemic status of the patients. But no association between chronic periodontitis and anemia and the effect of periodontal treatment on anemic status of the patients mentioned in the study.

Siddeshappa et al.,2016 [44] in his study stated that decrease in the hematological parameters after nonsurgical periodontal therapy helped to reduce the risk of atherosclerosis formation in the blood vessels and prevent cardiovascular diseases.

Anumolu et al., 2016 [45] stated that the treatment of periodontitis leads to an improvement in hematocrit and other related blood parameters in chronic generalized periodontitis patients with anemia that provides evidence that periodontitis like other chronic diseases may also cause anemia.

Conclusion

Based on the results obtained, we conclude that there is no association of Hemoglobin levels with Healthy, Gingivitis, Chronic and Aggressive Periodontitis patients. The occurrence of the two may be independent of each other. The limitation of the study is availability of small sample size. Hence further long term clinical trials are needed to understand the underlying linking mechanism between the hematological parameters and periodontal disease.

REFERENCES

1. Darveau RP, Tanner A, Page RC. The microbial challenge in periodontitis [Internet]. Vol. 14, Periodontology 2000. 1997. p. 12–32. Available from: http://dx.doi.org/10.1111/j.1600-0757.1997.tb00190.x
2. Nishihara T, Koseki T. Microbial etiology of periodontitis [Internet]. Vol. 36, Periodontology 2000. 2004. p. 14–26. Available from: http://dx.doi.org/10.1111/j.1600-0757.2004.03671.x
3. Berezow AB, Darveau RP. Microbial shift and periodontitis [Internet]. Vol. 55, Periodontology 2000. 2011. p. 36–47. Available from: http://dx.doi.org/10.1111/j.1600-0757.2010.00350.x
4. Page RC. The role of inflammatory mediators in the pathogenesis of periodontal disease [Internet]. Vol. 26, Journal of Periodontal Research. 1991. p. 230–42. Available from: http://dx.doi.org/10.1111/j.1600-0765.1991.tb01649.x
5. Johansson A. Periodontitis: From Dysbiotic Microbial Immune Response to Systemic Inflammation. MDPI; 2020. 12 p.
6. Graves DT, Li J, Cochran DL. Inflammation and Uncoupling as Mechanisms of Periodontal Bone Loss [Internet]. Vol. 90, Journal of Dental Research. 2011. p. 143–53. Available from: http://dx.doi.org/10.1177/0022034510385236
7. Michel J-P. Prevention of Chronic Diseases and Age-Related Disability. Springer; 2018. 199 p.
8. Dung S-Z. Asian Aspects of Periodontology and Implantology. 臺灣牙周病醫學會&Airiti Press; 2017. 354 p.
9. Beck JD, Offenbacher S. The Association Between Periodontal Diseases and Cardiovascular Diseases: A State-of-the-Science Review [Internet]. Vol. 6, Annals of Periodontology. 2001. p. 9–15. Available from: http://dx.doi.org/10.1902/annals.2001.6.1.9
10. Virdi M. Oral Health Care: Prosthodontics, Periodontology, Biology, Research and Systemic Conditions. BoD – Books on Demand; 2012. 384 p.
11. Shah R, Davis B. Nourish: The Definitive Plant-Based Nutrition Guide for Families--With Tips & Recipes for Bringing Health, Joy, & Connection to Your Dinner Table. Simon and Schuster; 2020. 416 p.
12. World Health Organization. Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks. World Health Organization; 2009. 62 p.
13. Hirschfeld J, Chapple ILC. Periodontitis and Systemic Diseases: Clinical Evidence and Biological Plausibility. Quintessenz Verlag; 2021. 360 p.
14. Henderson B, Curtis M, Seymour R. Periodontal Medicine and Systems Biology. John Wiley & Sons; 2009. 449 p.
15. Fredriksson M, Gustafsson A, Asman B, Bergström K. Hyper-reactive peripheral neutrophils in adult periodontitis: generation of chemiluminescence and intracellular hydrogen peroxide after in vitro priming and FcgammaR-stimulation. J Clin Periodontol. 1998 May;25(5):394–8.
16. Hutter JW, van der Velden U, Varoufaki A, Huffels RAM, Hoek FJ, Loos BG. Lower numbers of erythrocytes and lower levels of hemoglobin in periodontitis patients compared to control subjects [Internet]. Vol. 28, Journal of Clinical Periodontology. 2001. p. 930–6. Available from: http://dx.doi.org/10.1034/j.1600-051x.2001.028010930.x
17. Lumley J, D'Cruz A, Hoballah J, Scott-Connor C. Hamilton Bailey's Physical Signs: Demonstrations of Physical Signs in Clinical Surgery, 19th Edition. CRC Press; 2016. 704 p.
18. Yamamoto T, Tsuneishi M, Furuta M, Ekuni D, Morita M, Hirata Y. Relationship Between Decrease of Erythrocyte Count and Progression of Periodontal Disease in a Rural Japanese Population [Internet]. Vol. 82, Journal of Periodontology. 2011. p. 106–13. Available from: http://dx.doi.org/10.1902/jop.2010.100211
19. Shi D, Meng H, Xu L, Zhang L, Chen Z, Feng X, et al. Systemic Inflammation Markers in Patients With Aggressive Periodontitis: A Pilot Study [Internet]. Vol. 79, Journal of Periodontology. 2008. p. 2340–6. Available from: http://dx.doi.org/10.1902/jop.2008.080192
20. 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):1241–8.
21. Paramasivam A, Priyadharsini JV, Raghunandhakumar S, Elumalai P. A novel COVID-19 and its effects on cardiovascular disease. Hypertens Res. 2020 Jul;43(7):729–30.
22. S G, T G, K V, Faleh A A, Sukumaran A, P N S. Development of 3D scaffolds using nanochitosan/silk-fibroin/hyaluronic acid biomaterials for tissue engineering applications. Int J Biol Macromol. 2018 Dec;120(Pt A):876–85.
23. Del Fabbro M, Karanxha L, Panda S, Bucchi C, Nadathur Doraiswamy J, Sankari M, et al. Autologous platelet concentrates for treating periodontal infrabony defects. Cochrane Database Syst Rev. 2018 Nov 26;11:CD011423.
24. Paramasivam A, Vijayashree Priyadharsini J. MitomiRs: new emerging microRNAs in mitochondrial dysfunction and cardiovascular disease. Hypertens Res. 2020 Aug;43(8):851–3.
25. Jayaseelan VP, Arumugam P. Dissecting the theranostic potential of exosomes in autoimmune disorders. Cell Mol Immunol. 2019 Dec;16(12):935–6.
26. Vellappally S, Al Kheraif AA, Divakar DD, Basavarajappa S, Anil S, Fouad H. Tooth implant prosthesis using ultra low power and low cost crystalline carbon bio-tooth sensor with hybridized data acquisition algorithm. Comput Commun. 2019 Dec 15;148:176–84.
27. Vellappally S, Al Kheraif AA, Anil S, Assery MK, Kumar KA, Divakar DD. Analyzing Relationship between Patient and Doctor in Public Dental Health using Particle Memetic Multivariable Logistic Regression Analysis Approach (MLRA2). J Med Syst. 2018 Aug 29;42(10):183.
28. Varghese SS, Ramesh A, Veeraiyan DN. Blended Module-Based Teaching in Biostatistics and Research Methodology: A Retrospective Study with Postgraduate Dental Students. J Dent Educ. 2019 Apr;83(4):445–50.
29. Venkatesan J, Singh SK, Anil S, Kim S-K, Shim MS. Preparation, Characterization and Biological Applications of Biosynthesized Silver Nanoparticles with Chitosan-Fucoidan Coating. Molecules [Internet]. 2018 Jun 12;23(6). Available from: http://dx.doi.org/10.3390/molecules23061429
30. Alsubait SA, Al Ajlan R, Mitwalli H, Aburaisi N, Mahmood A, Muthurangan M, et al. Cytotoxicity of Different Concentrations of Three Root Canal Sealers on Human Mesenchymal Stem Cells. Biomolecules [Internet]. 2018 Aug 1;8(3). Available from: http://dx.doi.org/10.3390/biom8030068
31. Venkatesan J, Rekha PD, Anil S, Bhatnagar I, Sudha PN, Dechsakulwatana C, et al. Hydroxyapatite from Cuttlefish Bone: Isolation, Characterizations, and Applications. Biotechnol Bioprocess Eng. 2018 Aug 1;23(4):383–93.
32. Vellappally S, Al Kheraif AA, Anil S, Wahba AA. IoT medical tooth mounted sensor for monitoring teeth and food level using bacterial optimization along with adaptive deep learning neural network. Measurement. 2019 Mar 1;135:672–7.

33. PradeepKumar AR, Shemesh H, Nivedhitha MS, Hashir MMJ, Arockiam S, Uma Maheswari TN, et al. Diagnosis of Vertical Root Fractures by Cone-beam Computed Tomography in Root-filled Teeth with Confirmation by Direct Visualization: A Systematic Review and Meta-Analysis. J Endod. 2021 Aug;47(8):1198–214.
34. R H, Ramani P, Tilakaratne WM, Sukumaran G, Ramasubramanian A, Krishnan RP. Critical appraisal of different triggering pathways for the pathobiology of pemphigus vulgaris-A review. Oral Dis [Internet]. 2021 Jun 21; Available from: http://dx.doi.org/10.1111/odi.13937
35. Ezhilarasan D, Lakshmi T, Subha M, Deepak Nallasamy V, Raghunandhakumar S. The ambiguous role of sirtuins in head and neck squamous cell carcinoma. Oral Dis [Internet]. 2021 Feb 11; Available from: http://dx.doi.org/10.1111/odi.13798
36. Sarode SC, Gondivkar S, Sarode GS, Gadbail A, Yuwanati M. Hybrid oral potentially malignant disorder: A neglected fact in oral submucous fibrosis. Oral Oncol. 2021 Jun 16;105390.
37. Kavarthapu A, Gurumoorthy K. Linking chronic periodontitis and oral cancer: A review. Oral Oncol. 2021 Jun 14;105375.
38. Vellappally S, Abdullah Al-Kheraif A, Anil S, Basavarajappa S, Hassanein AS. Maintaining patient oral health by using a xeno-genetic spiking neural network. J Ambient Intell Humaniz Comput [Internet]. 2018 Dec 14; Available from: https://doi.org/10.1007/s12652-018-1166-8
39. Aldhuwayhi S, Mallineni SK, Sakhamuri S, Thakare AA, Mallineni S, Sajja R, et al. Covid-19 Knowledge and Perceptions Among Dental Specialists: A Cross-Sectional Online Questionnaire Survey. Risk Manag Healthc Policy. 2021 Jul 7;14:2851–61.
40. Mdala I, Olsen I, Haffajee AD, Socransky SS, Thoresen M, Blasio BF. Comparing clinical attachment level and pocket depth for predicting periodontal disease progression in healthy sites of patients with chronic periodontitis using multi-state M arkov models [Internet]. Vol. 41, Journal of Clinical Periodontology. 2014. p. 837–45. Available from: http://dx.doi.org/10.1111/jcpe.12278
41. Mahajan A, Asi K, Thakur N, Rasila D. Dimorphic anemia and mental depression as a result of systemic manifestations of generalized aggressive periodontitis: A pioneer case report. J Indian Soc Periodontol. 2017 Sep;21(5):412–6.
42. Wu D, Lin Z, Zhang S, Cao F, Liang D, Zhou X. Decreased Hemoglobin Concentration and Iron Metabolism Disorder in Periodontitis: Systematic Review and Meta-Analysis [Internet]. Vol. 10, Frontiers in Physiology. 2020. Available from: http://dx.doi.org/10.3389/fphys.2019.01620
43. Patel M, Shakir Q, Shetty A. Interrelationship between chronic periodontitis and anemia: A 6-month follow-up study [Internet]. Vol. 18, Journal of Indian Society of Periodontology. 2014. p. 19. Available from: http://dx.doi.org/10.4103/0972-124x.128194
44. Siddeshappa ST, Nagdeve S, Yeltiwar RK, Parvez H, Deonani S, Diwan V. Evaluation of various hematological parameters in patients with periodontitis after nonsurgical therapy at different intervals. J Indian Soc Periodontol. 2016 Mar;20(2):180–3.
45. Anumolu VNSH, Srikanth A, Paidi K. Evaluation of the relation between anemia and periodontitis by estimation of blood parameters: A cross-sectional study. J Indian Soc Periodontol. 2016 May;20(3):265–72.