NexAvens Scientific Library

OPEN ACCESS

NL Journal of Dentistry and Oral Sciences

(ISSN: 3049-1053)

Volume 2 Issue 1 February 2025

Research Article

Evaluation of the Prevalence and Correlation of Periodontal Bone Status with Associated Risk Factors – A Retrospective Radiographic Study

Ayman Ahmed

Corresponding Author: Ayman Ahmed, Professor, Department of basic & clinical oral sciences, College of Dental Medicine, Umm Al-qura University, Makkah, Saudi Arabia.

DOI: 10.71168/NDO.02.01.105

Received Date: January 15- 2025 **Publication Date:** January 30- 2025

Abstract

Introduction: Radiographic assessment of periodontal bone status is a beneficial diagnostic aid to clinical periodontal examination and may be used in screening of periodontitis caused by interplays between periodontopathogenic bacteria and host's immune response inflicted by risk factors. This study intended to assess the prevalence and correlation of periodontal bone status with associated risk factors.

Methods: This retrospective study used the records of patients attended in 2019. Recorded data, such as age, gender, smoking, oral hygiene status and systemic condition, were obtained without including any identifying information. Periodontal bone status was assessed by measuring the proportion of total bone height to the total root length in panoramic radiographs. Data were arranged in tables, and statistically analyzed using Pearson correlation coefficient.

Results: Of the total 2,610 patients' panoramic radiographs, 1521 (58.3%) showed periodontal bone loss, while 1089 (41.7%) showed healthy periodontium without periodontal bone loss. The frequency of patients with healthy periodontium was statistically greater in those with good oral hygiene, non-smokers and those without associated systemic diseases. Furthermore, the frequency of patients with mild-to-moderate periodontitis and those with severe periodontitis was statistically greater in smokers, those with associated systemic disease, and those with fair and poor oral hygiene.

Conclusion: A significant positive correlation exists between periodontal bone loss and smoking, fair-to-poor oral hygiene and associated systemic diseases. Radiographic assessment of periodontal bone loss is a rapid and accessible tool in periodontitis screening studies.

Keywords: Periodontal bone status, Periodontitis, Risk factors

Introduction

Periodontal diseases are common, complicated interplays between periodontopathogenic bacteria and the host's immune response inflicted by risk factors such as smoking, diabetes mellitus, hypertension, stress and heredity. Periodontal disease amelioration results in attachment and alveolar bone loss and consequential tooth mobility [1]. Periodontal diagnosis employing full-mouth clinical examination is well thought-out the "gold standard" to settle subject periodontal status [2]. However, clinical examination demands the evaluation of many parameters and the registering of a lot of information which take a lot of time and effort both for patients and examiners, that may lead to assessment inaccuracy and substantial abandon [3,4].

Radiographic assessment is crucial for demonstrating interproximal periodontal bone levels to figure out the treatment plan, prognosis of periodontally-affected teeth and providing baseline information for the assessment of treatment outcomes [5]. Additionally, it emerges as essential to periodontitis classification grounded on stages described by severity, and grades reflecting disease advancement [6]. Moreover, radiographic examination displays an accessible and satisfactory method that exhibited a strong correlation with the clinical findings and clinical attachment loss [7,8].

Panoramic radiographs offer a general elaboration of the severity and extent of periodontal disease and the allocation of bony defects, particularly in the measurement of periodontal bone loss [9] that was successfully confirmed as a trustworthy tool for extensive surveillance studies [10]. By virtue of the diminished radiation dose, panoramic radiographs are usually the only radiographs used in epidemiological surveys and regarded as a regular diagnostic aid providing a precious screening chance. Furthermore, the certainty of panoramic radiograph-grounded periodontal bone loss being a screening implement for periodontitis diagnosis under the 2018 case definition was reported as a reliable tool in periodontitis cases screening and surveillance [11].

Our dental teaching hospital provides dental services to many patients with various age, ethnicity, nationalities, and socioeconomic status. Therefore, it provides an opportunity to know about the extent and the severity of periodontal disease in our city population, which help establish a community-based program to increase the awareness of periodontal disease prevention and detect periodontitis early in the mild forms to prevent progression to more severe forms. Moreover, although previous studies on the prevalence of periodontal bone loss in our country have been undertaken [12-14], periodontal bone loss prevalence and correlation with associated risk factors has not been studied in our city. Hence, the aim of this study was to evaluate the prevalence and correlation of periodontal bone status with associated risk factors among the university dental teaching hospital patients.

Materials and Methods

Study design

Participants included in this retrospective study were patients who sought dental treatment from January to December 2019 with a total number of 2983 patients using their routinely done panoramic radiographs before their examination. Blind, standardized, recorded data on gender, age, oral hygiene status using the Silness and Loe plaque index [15], smoking status and systemic condition were obtained from patients' records without including any identifying information. Inclusion criteria were panoramic radiographs from dentulous patients above 18 years of age. Exclusion criteria were set to rule out poor-quality images and records with insufficient data.

Panoramic radiographs were taken using Gendex Orthoralix 9200 DDE Digital Cephalometric and Panoramic X-Ray (Gendex Dental System, USA). Panoramic radiographs' quality was assessed following the criteria submitted by Sabarudin and Tiau [16]. Each image was scored with a 4-point numerical grading scale addressing anatomical coverage, density and contrast as well as anatomical structures.
Anatomical coverage scales were 1. Inappropriate coverage 2. Suspected coverage 3. Visibility of coverage relevant to clinical needs 4. Optimal coverage.

Density and contrast scales comparing enamel to dentin were 1. Poor density and inadequate contrast 2. Unsatisfactory density with adequate contrast 3. Satisfactory density and contrast 4. Excellent density and contrast.

Anatomical structures scales were 1. Significant structures are not visible 2. Only broad details seen 3. Small details are visualized 4. Fine details are visualized. Panoramic radiograph was rated as better image quality when it had all the scores with 3 or 4 numerical grading whereas all scores' grading of 1 or 2 indicated poor image quality [17].

Radiographic examination was performed with a high-resolution computer monitor in a dark room by a single examiner. Periodontal bone status was assessed by calculating the proportion of the linear measurement total bone height (distance from the tooth's apex to alveolar bone crest) to the total root length (distance from the tooth's apex to CEJ) in all teeth. Adopting the standardized formality by Rydén et al. [10], healthy periodontium was considered when the proportion was ≥ 80%, while mild-to-moderate Periodontitis was described when the proportion was 79 - 66%, whereas severe periodontitis was defined when the proportion was < 66%. The assessments for the same radiographs were registered twice and the first assessment was sightless for the purpose of intraexaminer reliability.

Statistical Analysis

Data were gathered, tabulated and then analyzed using SPSS version 20. They were displayed as frequencies, and comparisons were made using the chi-squared test (X2) while correlations were evaluated using Pearson correlation coefficients (r). P-values less than 0.05 were considered significant.

Results

A total of 2983 patient records were examined, out of which 373 records were excluded due to absent or insufficient recorded data or low-quality panoramic radiographs. Out of the total 2610 records, Oral hygiene status was poor in 795 (30.5%) patients, fair in 982 (37.6%) patients and good in 833 (31.9%) patients, whereas 1178 (45.1%) were current smokers and 1432 (54.9%) were non-smokers. Regarding associated systemic diseases, 995 (38.1%) patients had no associated systemic diseases, while 1046 (40.1%) had diabetes mellitus and 569 (21.8%) had hypertension.

Periodontal bone loss was found in 1521 (58.3%) panoramic radiographs while 1089 (41.7%) radiographs showed healthy periodontium without periodontal bone loss.

Periodontal bone status and oral hygiene status

Table (I) shows the frequency of periodontal bone status in relation to oral hygiene status. The frequency of patients with healthy periodontium was found mostly in those with good oral hygiene and dramatically declined with fair and poor oral hygiene (p = 0.000). The frequency of patients with mild-to-moderate periodontitis and those with severe periodontitis was rising progressively with oral hygiene worsening and mostly with poor oral hygiene (p = 0.000). The Pearson correlation value (r = -0.689) indicated a significant negative correlation between oral hygiene status and periodontitis development and severity.

	Healthy Periodontium	**Mild-to-Moderate Periodontitis**	**Severe periodontitis**	**Total**
	N (%)	**N (%)**	**N (%)**	**N (%)**
Good	791 (30.3%)	31 (1.2%)	11 (0.4%)	833 (31.9%)
Fair	286 (10.9%)	423 (16.2%)	273 (10.6%)	982 (37.6%)
Poor	12 (0.5%)	466 (17.8%)	317 (12.1%)	795 (30.5%)
Total				
	1089 (41.7%)	920 (35.2%)	601 (23.1%)	2610 (100%)
X^2 (P value)	183.62 (0.000)*	153.47 (0.000)*	136.78 (0.000)*	117.69 (0.000)*
Pearson's R (P value)	-0.689 (0.000)*			

Table 1. Frequency of periodontal bone status in relation to oral hygiene status

*Significant at p value < 0.05
X^2 chi square test

Periodontal bone status and smoking

Table (II) shows the frequency of periodontal bone status in relation to smoking. The frequency of patients with healthy periodontium was statistically greater in non-smokers than smokers (p = 0.000). In contrast, the frequency of patients with mild-to-moderate periodontitis and those with severe periodontitis was statistically greater in smokers than non-smokers (p = 0.000). The Pearson correlation value (r= 0.794) indicated a significant positive correlation between smoking and the severity of periodontitis.

	Healthy Periodontium	Mild-to-Moderate Periodontitis	Severe periodontitis	Total
	N (%)	N (%)	N (%)	N (%)
Smokers	127 (4.9%)	614 (23.5%)	437 (16.8%)	1178 (45.1%)
Nonsmokers	962 (36.8%)	306 (11.7%)	164 (6.3%)	1432 (54.9%)
Total				
	1089 (41.7%)	920 (35.2%)	601 (23.1%)	2610 (100%)
X^2 (P value)	147.58 (0.000)*	126.41 (0.000)*	132.74 (0.000)*	121.83 (0.000)*
Pearson's R (P value)	0.794 (0.000)*			

Table 2. Frequency of periodontal bone status in relation to smoking

*Significant at p value < 0.05
X^2 chi square test

Periodontal bone status and associated systemic disease

Table (III) shows the frequency of periodontal bone status in relation to associated systemic disease. The frequency of patients with healthy periodontium was statistically greater in those without associated systemic disease than those with associated systemic disease (p = 0.000). Conversely, the frequency of patients with mild-to-moderate periodontitis and those with severe periodontitis was significantly greater in those with associated systemic disease than those without associated systemic disease (p = 0.000). Moreover, the frequency of diabetic patients with mild-to-moderate and severe periodontitis (15.7% and 13.2% respectively) was statistically greater than hypertensive patients (8.3% and 6.7% respectively). The Pearson correlation value (r= 0.479) showed a significant positive correlation between the association of systemic diseases and the severity of periodontitis.

	Healthy Periodontium	Mild-to-Moderate Periodontitis	Severe periodontitis	Total
	N (%)	N (%)	N (%)	N (%)
No associated systemic disease	619 (23.7%)	293 (11.2%)	83 (3.2%)	995 (38.1%)
Diabetes mellitus	291 (11.2%)	411 (15.7%)	344 (13.2%)	1046 (40.1%)
Hypertension	179 (6.8%)	216 (8.3%)	174 (6.7%)	569 (21.8%)
Total				
	1089 (41.7%)	920 (35.2%)	601 (23.1%)	2610 (100%)
X^2 (P value)	168.12 (0.000)*	123.42 (0.000)*	139.58 (0.000)*	143.57 (0.000)*
Pearson's R (P value)	0.479 (0.000)*			

Table 3. Table 3. Frequency of periodontal bone status in relation to associated systemic disease

*Significant at p value < 0.05
X^2 chi square test

Discussion

The present study was conducted to evaluate the prevalence and correlation of periodontal bone status to associated risk factors among patients attended to Umm Al-qura university dental teaching hospital during the year 2019 using panoramic radiographs. Panoramic radiographs were used in this study as they are taken routinely before examination to all patients attending the hospital for any kind of dental services, whereas full-mouth periapical and bite wing radiographs are taken adjunctively only to a small number of patients who will be treated in the comprehensive care clinic for full-mouth rehabilitation. The author tried to take as large sample size as possible to be a true representative of the Makkah population. Besides, it had been reported that panoramic and intraoral radiographic periodontal bone loss measurements had been evidenced to be clinically coinciding [18]. Moreover, only high-quality panoramic images having all the scores with 3 or 4 numerical grading based on the criteria submitted by Sabarudin and Tiau [16] were used in this study.

Genetics, stress, smoking, systemic diseases and poor oral hygiene are risk factors that had been well demonstrated in the literature to be implicated in periodontal disease initiation and progression [19]. The current study revealed that 56.7% of the study population presented with different forms of periodontitis had fair to poor oral hygiene and a significant negative correlation was found between oral hygiene status and the evolution of periodontitis, which advocates improving oral hygiene status to minimize the risk of acquiring periodontal disease. Earlier studies reported coincident results that fair to poor oral hygiene increases the risk of periodontitis by two- to five-fold [20,21]. This could be due to pathogenic bacterial dental biofilm implication in tissue destruction as well as their ability to provoke an inflammatory immune host response that leads to the release of inflammatory mediators involved in alveolar bone resorption and periodontal tissue damage.

The results of the present study showed a significant difference between smokers and non-smokers in all patients with different periodontal bone status and a significant positive correlation between smoking and the development and severity of periodontal bone loss. These results are in line with several epidemiological and clinical studies that confirmed an adverse impact of smoking on periodontal health [22,23]. Smoking adversely alters the host's response via impairing neutrophils functions, decreasing fibroblast proliferation and collagen production, vasoconstrictive effects, as well as increasing collagenase and osteoclastic activity [24]. Furthermore, clinical attachment loss and bone resorption was reported to be two to five times greater in smokers than non-smokers [25].

In the current study, the frequency of patients with mild-to-moderate periodontitis and those with severe periodontitis was significantly greater in those with associated systemic disease than those without associated systemic disease. Diabetes mellitus and hypertension were the only systemic diseases involved in the present study, as they are the disorders most commonly reported to have a relationship with periodontal disease in the literature. The significant positive correlation between the association of systemic diseases and periodontal bone loss in this study was consistent with previous studies suggesting that these systemic diseases exaggerate periodontal destruction [26,27].

Chronic inflammation may be the main mechanism linking diabetes and periodontitis. Many studies suggest that diabetes produces a state of chronic inflammation. The level of circulating tumor necrosis factor (TNF) in diabetic patients was found to be higher than that in non-diabetic patients, and the inflammatory level in different tissues was also higher and mainly manifested as increased vascular permeability and inflammatory cell infiltration [28]. Moreover, it has been shown that chronic hyperglycemia might activate various mechanisms that result in oxidative stress, augmented inflammation and apoptosis [29].

Conversely, periodontal disease could exert an adverse impact on glycemic control in diabetic patients. Periodontitis could cause increased systemic amounts of TNF-α, interleukin-6 and C-reactive protein along with the resultant enhanced systemic inflammation, which might contribute to insulin resistance. Moreover, periodontitis was reported to increase oxidative stress, which leads to cytokine imbalance and immune dysfunction. As a result, HbA1c levels were elevated in the blood and glucose transporter-4 receptor transcription was reduced, resulting in impaired insulin secretion, which might lead to chronic hyperglycemia [30]. Additionally, periodontal therapy was found to significantly reduce glycated hemoglobin levels in diabetic patients through the significant reduction of systemic inflammation levels, which might restore insulin sensitivity, thereby improving glycemic control [31].

Most of the systematic reviews and meta analyses studies reported a positive association between hypertension and periodontitis. Whether the relationship between periodontitis and hypertension is causal or casual is uncertain. Periodontitis and hypertension share common denominators, such as smoking, older age, overweight/obesity and stress. However, a common genetic background involving genes entailed in the immune function was demonstrated [32]. The same allele was found to be correlated with both enhanced level of blood pressure and periodontitis documenting a causal genetic relationship between hypertension and periodontitis which implicated the immune system. A high-salt diet, environmental provocative for hypertension, taken for one week was found to diminish neutrophils antibacterial responses through increasing glucocorticoid production which results in immunosuppression [33].

Similarly, various studies have documented that hypertensive patients exhibit a more severe periodontal status [34]. Clinical and experimental evidence suggests that this bond might exist because hypertension causes microcirculatory ischemia, altered bacterial composition of the biofilm, enhanced inflammation and increased oxidative stress. On the other hand, periodontitis might lead to increased chronic systemic inflammation with increased inflammatory biomarkers and endothelial dysfunction, which might increase the risk of developing hypertension. Likewise, periodontitis was found to be associated with a higher likelihood of uncontrolled hypertension despite the administration of antihypertensive medications [35]. Additionally, periodontal therapy was reported to present a parallel improvement in blood pressure profile after treatment [32], proving that inflammation could be a plausible link between hypertension and periodontitis.

The present study has some limitations in that it is a single-center study, and its results cannot be generalized since hospital patients yield greater estimates of the disease than field studies. Panoramic radiography does not reveal the extent of involvement on the facial and lingual surfaces and lacks accurate imaging of osseous defects three-dimensionally. Moreover, other factors that might have influenced systemic conditions and hence periodontal disease severity was not described, such as glycemic control, the duration since diabetes had been diagnosed, abdominal obesity, stress and salt intake.

Conclusion

A significant positive correlation exists between periodontal bone loss and smoking, fair-to-poor oral hygiene as well as diabetes mellitus and hypertension. Radiographic assessment of periodontal bone loss is a rapid and accessible tool in periodontitis screening studies.

References

1. Wagner M, Kassebaum NJ, Bernabé E. Global burden of oral conditions in 1990-2010: a systematic analysis. J Dent Res. 2013; 92: 592-597.

2. Botelho, J.; Machado, V.; Proença, L.; Mendes, J.J. The 2018 periodontitis case definition improves accuracy performance of full-mouth partial diagnostic protocols. Sci. Rep. 2020; 10: 1–7.

3. Kingman, A.; Susin, C.; Albandar, J.M. Effect of partial recording protocols on severity estimates of periodontal disease. J. Clin. Periodontol. 2008; 35: 659–667.

4. Listgarten M.A. Periodontal probing: What does it mean? J. Clin. Periodontol. 1980;7: 165–176.

5. Papapanou, P.N.; Sanz, M.; Buduneli, N.et al. Periodontitis: Consensus report of workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J. Clin. Periodontol. 2018; 45: 162–170.

6. Lang, N.P.; Bartold, P.M. Periodontal health. J. Clin. Periodontol. 2018; 45: 9–16.

7. Papapanou P.N. and Wennstrom J.L.. Radiographic and clinical assessments of destructive periodontal disease. J. Clin. Periodontol. 1989; 9: 609–612.

8. Hausmann E., Allen K., Norderyd J., Ren W., Shibly O., and Machtei E. Studies on the relationship between changes in radiographic bone height and probing attachment. J. Clin. Periodontol. 1994; 2: 128–132.

9. Krois, J.; Ekert, T.; Meinhold, et al. Deep Learning for the Radiographic Detection of Periodontal Bone Loss. Sci. Rep. 2019; 9: 8495-8516.

10. Rydén L.; Buhlin K.; Ekstrand E. et al. Periodontitis Increases the Risk of a First Myocardial Infarction: A Report From the PAROKRANK Study. Circulation. 2016; 133: 576–583.

11. Vanessa M, Luís P, Mariana M, José M, João B. Accuracy of Panoramic Radiograph for Diagnosing Periodontitis Comparing to Clinical Examination. J. Clin. Med. 2020; 9: 2313- 2324.

12. Al-Zahrani MS, Kayal RA. Alveolar bone loss and reported medical status among a sample of patients at a Saudi dental school. Oral Health Prev Dent. 2006; 4: 113-118.

13. Natto ZS, Al-Zahrani MS. Periodontal bone loss and self-reported medical conditions in a dental school patient population. J Int Acad Periodontol. 2010; 12: 104-109.

14. Al-Emadi A, Bissada N, Farah C, Siegel B, Al-Zaharani M. Systemic diseases among patients with and without alveolar bone loss. Quintessence Int. 2006; 37: 761-765.

15. Silness J, Löe H. Periodontal Disease in Pregnancy. II. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand 1964; 22: 121-135.

16. Sabarudin, A.; Tiau, Y.J. Image quality assessment in panoramic dental radiography: A comparative study between conventional and digital systems. Quant. Imaging Med. Surg. 2013; 3: 43–48.

17. Gijbels F, De Meyer AM, Bou Serhal C, et al. The subjective image quality of direct digital and conventional panoramic radiography. Clin Oral Investing 2000; 4: 162-167.

18. Persson, R.E.; Tzannetou, S.; Feloutzis, A.G.; Brägger, U.; Persson, G.R.; Lang, N.P. Comparison between panoramic and intra-oral radiographs for the assessment of alveolar bone levels in a periodontal maintenance population. J. Clin. Periodontol. 2003, 30, 833–839.

19. Van Dyke TE, Sheilesh D. Risk factors for periodontitis. J Int Acad Periodontol. 2005; 7: 3-7.

20. Attawood L, Sasivimol R, Sakda A, John A and Ammarin T. The association between oral hygiene and periodontitis: a systematic review and meta-analysis. Int Dent J. 2017; 67: 332–343.

21. Tonetti MS, Eickholz P, Loos BG, et al. Principles in prevention of periodontal diseases: consensus report of group 1 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases. J Clin Periodontol. 2015; 42: S5–S11.

22. Albandar JM, Streckfus CF, Adesanya MR, Winn DM. Cigar, pipe, and cigarette smoking as risk factors for periodontal disease and tooth loss. J Periodontol. 2000; 71: 1874-1881.

23. Ah MK, Johnson GK, Kaldahl WB, Patil KD, Kalkwarf KL. The effect of smoking on the response to periodontal therapy. J Clin Periodontol. 1994; 21: 91-97.

24. Obeid P, Bercy P. Effects of smoking on periodontal health: a review. Adv Ther. 2000; 17: 230-237.

25. Baljoon M, Natto S, Bergstrom J. Long-term effect of smoking on vertical periodontal bone loss. J Clin Periodontol. 2005; 32: 789-797.

26. Mittal M, Teeluckdharry H. Prevalence Of Periodontal Diseases In Diabetic And Non-Diabetic Patients. A Clinical Study. The Internet Journal of Epidemiology. 2010; 10: 1-5.

27. Muñoz Aguilera E, Suvan J, Buti J, Czesnikiewicz-Guzik M, Barbosa Ribeiro A, Orlandi M, Guzik TJ, Hingorani AD, Nart J, D'Aiuto F. Periodontitis is associated with hypertension: a systematic review and meta-analysis. Cardiovasc Res. 2020; 116: 28–39.

28. Daniele G, Guardado Mendoza R, et al. The inflammatory status score including IL-6, TNF-α, osteopontin, fractalkine, MCP-1 and adiponectin underlies whole-body insulin resistance and hyperglycemia in type 2 diabetes mellitus. Acta Diabetol 2014; 51: 123-131.

29. Polak D, Shapira L. An update on the evidence for pathogenic mechanisms that may link periodontitis and diabetes. J Clin Periodontol 2018; 45: 150-166.

30. Graziani F, Gennai S, Solini A, Petrini M. A systematic review and meta-analysis of epidemiologic observational evidence on the effect of periodontitis on diabetes an update of the EFP-AAP review. J Clin Periodontol. 2018; 45: 167–187.

31. Preshaw PM, Taylor JJ, Jaedicke KM, et al. Treatment of periodontitis reduces systemic inflammation in type 2 diabetes. J Clin Periodontol 2020; 47: 737-746.

32. Czesnikiewicz-Guzik M, Osmenda G, Siedlinski M. Causal association between periodontitis and hypertension: evidence from Mendelian randomization and a randomized controlled trial of non-surgical periodontal therapy. Eur Heart J 2019;40:3459–3470.

33. Jobin K, Stumpf NE, Schwab S, Eichler M, Neubert P, Rauh M. A high-salt diet compromises antibacterial neutrophil responses through hormonal perturbation. Sci Transl Med 2020;12:1-13.

34. Muñoz Aguilera E, Suvan J, Buti J et al. Periodontitis is associated with hypertension: a systematic review and meta-analysis. Cardiovasc Res. 2020; 116: 28–39.

35. Rita Del P, Luca L, Guido Gi, et al. Hypertension and Periodontitis: A Joint Report by the Italian Society of Hypertension (SIIA) and the Italian Society of Periodontology and Implantology (SIdP). High Blood Press Cardiovasc Prev. 2021; 28: 427–438.