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Research Paper: Evaluation of Periodontal Bony Lesions in the Iranian Population

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ABSTRACT

Introduction: The present study aimed to assess the prevalence of periodontal bony lesions in radiographs in the Iranian population.

Materials and Methods: In this analytical cross-sectional study, 440 radiographic images of patients aged 15-60 years were selected based on the study's inclusion criteria. Two researchers evaluated all radiographs and recorded patient age, gender, and bone-related lesions (horizontal , vertical and furca involvement) in a checklist. Chi-square test was used for data analysis. (α=0.05).

Results: 273 images (62.05%) had no lesions and 167 images (37.95%) had lesions. In the 167 examined images, a total of 845 bone lesions were observed . The highest frequency was in horizontal lesions in the anterior mandible and central incisor teeth and the lowest type of lesion was related to vertical lesions in the posterior mandible and in the third molar ($P<0.001$). The most types of bone lesions; Based on the type of tooth, was related to horizontal lesions in the lateral incisor and the lowest type of lesion was related to vertical lesions in the first premolar tooth ($P<0.001$). Based on restoration, the most related to horizontal lesions in amalgam and the least related to vertical lesions and furca in veneer ($P<0.001$). Based on the contact status, the most was related to horizontal lesions in open contact and the least was related to vertical lesions ($P<0.001$).

Conclusion: Based on this study, there is a significant association between the type of periodontal bony lesion and involved teeth, restoration type, contact status, presence of calculus on radiographs.

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Introduction

The initial diagnosis of periodontal disease is crucial for preservation of teeth, and overall patient health. Periodontal diseases have been progressing rapidly in many countries and destructive periodontitis found in approximately 15% of the American population (1-3).

Periodontal disease is a highly prevalent inflammatory-infectious disease with multifactorial origins. It is influenced by genetic, environmental, and microbial factors, and understanding the pathogenic factors contributes to the recognition, progression, and extension of the disease (4-6).

The two common forms of this disease are gingivitis (inflammation of the soft tissue surrounding the teeth) and periodontitis (destruction of supportive dental structures, including periodontal ligament, bone, cementum, and soft tissue).

The main causative factors of periodontal diseases are dental plaque and calculus. Dental plaque is an organized structure containing microorganisms embedded in a glycoprotein matrix from saliva and extracellular polysaccharides. Dental calculus results from mineralization of dental plaque. The initiation of periodontal diseases involves the growth of specific bacterial species, mostly Gram-negative and anaerobic bacteria, in subgingival areas.

Periodontal disease occurs as a result of the interplay between subgingival biofilm and the host immune-inflammatory system in periodontal tissues, following the challenges posed by bacteria (7,8).

The host response to periodontal pathogens leads to chronic inflammation, which subsequently results in the destruction of supporting periodontal tissues. The morphology of periodontal bone lesions is determined by various factors, including the location of the pathogenic microorganisms on the root, root surface characteristics, alveolar bone thickness, root position along the alveolus, and relationship with adjacent periodontal lesions (9).

The identification of periodontal bone lesions, including vertical and angular defects, fenestration, and dehiscence, is challenging for dentists since they are not visible to the naked eye. Therefore, a thorough examination of the bone is necessary for accurate diagnosis and treatment planning, and knowledge of the shape and morphology of bone components is essential for the treatment of teeth with periodontal involvement (10).

Different methods are used to identify periodontal lesions, including probing (determining pocket depth and loss of attachment), sounding for evaluating the shape of bone lesions, and radiographic examination of periodontal lesions (11). Having an accurate depiction of the morphology of periodontal bone destruction is one of the crucial factors for the success of periodontal treatment and determining prognosis. The use of radiographs is necessary to visualize structures that are not visible to the naked eye, such as alveolar bone (12).

Currently, the diagnosis of periodontal bone lesions and the evaluation of the healing process of these lesions are performed through radiographic examination (13). Early diagnosis of a bone lesion undoubtedly affects the prognosis of the disease and the effectiveness of treatment. Neglecting bone lesions leads to delayed diagnosis and treatment, often requiring more invasive interventions (14). Therefore, the identification and prevalence of bone lesions in patients are of great importance. The aim of this study is to investigate the prevalence of bone lesions in radiographs within the Iranian population.

Materials and Methods

This analytical cross-sectional study was conducted in the Periodontics Department of the Dental school at Guilan University of Medical Sciences. All patients were selected with informed consent to investigate their radiographic images. Ethical approval for the research was obtained from Guilan University

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Patient selection was performed based on the selection of panoramic and bite wing images. Complete patient information, including the type and location of the lesion, was recorded in the patient files. The study included patients aged 15-60 years with complete dental records, bitewing radiographs, and panoramic radiographs. Patients without teeth, presence of artifacts or radiographic errors in the examined images, and incomplete patient information were excluded from our statistical population.440 radiographic images were selected based on the study's inclusion criteria. The identified lesion types were further investigated based on the patients' files. Patient data, including lesion type, age, gender, lesion location.

The radiographic images were captured using a CranexD panoramic device (Soredex-Tuusula, Finland) at 81 kV and 10 mA. The digital images were reviewed on a 22-inch Samsung LED monitor with a resolution of 1080 x 1920 pixels using Scanora software (version 5.0.2, Soredex-Finland) to ensure uniformity in the physical properties of the radiographs. Two researchers evaluated all radiographs and recorded patient age, gender, and bone-related lesions in a checklist.

For classifying the types of lesions, the diagnostic criterion was the distance between the cement-enamel junction (CEJ) and the crest of the alveolar bone. If the distance exceeded 2 millimeters, it was considered as loss of crestal bone. For horizontal and vertical bone lesions, lines were drawn from the CEJ of one tooth to the CEJ of an adjacent tooth and from one crestal bone level to another. If the distance between these two lines exceeded 2 millimeters and remained parallel, it was considered a horizontal bone lesion. If the distance exceeded 2 millimeters at all points but was non-parallel, it was considered a vertical bone lesion. Defects related to furcation involvement were considered if there was a decrease in density in the furcation area visible on radiographs, with visible bone trabeculae. The histopathology of bone lesions was not included in this study.

Qualitative data were described using frequency and percentage, while quantitative data were described using mean and standard deviation. Descriptive tables and graphs were used to depict both measurement scales. The Chi-square test was used for inferential analysis. SPSS 28 was used for statistical analyses at a significance level of $P<0.05$

Results

In this study, a total of 440 radiographic images from patients aged 15 to 60 years were evaluated. Among these, 273 images (62.05%) showed no bone lesions, while 167 images (37.95%) exhibited bone lesions. In the 167 examined images, a total of 845 bone lesions were observed. The patients who participated in the study had a minimum age of 15 years and a maximum age of 60 years, with a mean age of 26.32±6.261.

Among the evaluated radiographic images, 220 (50%) were from males and 220 (50%) were from females. Table 1 presents the frequency of variables in this study. The most common type of bony lesion was horizontal bone loss (83.55%), while vertical bone lesions had the lowest prevalence (6.86%). The most frequent location for bony lesions was in the mandibular anterior teeth (38.70%), while the least common location was in the maxillary anterior teeth (13.96%).

In terms of the involved tooth type, the highest percentage of bony lesions was found in central incisors (20.59%), followed by lateral incisors (19.88%), and the least affected tooth type was the third molar (3.91%). Additionally, the most prevalent bony lesion based on the type of restoration was related to amalgam restorations (5.44%), while teeth restored with composite materials had the lowest prevalence (50.83%).

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Table 1. Frequency of the variables in the study

Variable		N	%
Lesion type	Vertical	58	6.86
	Horizontal	706	83.55
	Furcation	81	9.59
Sex	Male	205	50
	Female	205	50
The site of incidence	Posterior mandible	237	28.05
	Anterior mandible	327	38.70
	Posterior maxilla	163	19.29
	Posterior maxilla	118	13.96
Type of the involved tooth	Central incisor	174	20.59
	Lateral incisor	163	19.88
	Canine	110	13.02
	First premolar	81	9.59
	Second premolar	81	9.59
	First molar	111	13.14
	Second molar	87	10.30
	Third molar	33	3.91
Restoration	Composite	7	0.83
	Amalgam	46	5.44
	Crown	9	1.07
Contact	No contact	626	55.94
	Open contact	493	44.06
Plaque	Positive	408	36.46
	Negative (Plaqueless)	711	63.54

Table 2 shows the prevalence of involved teeth based on involved anatomical areas of jaws. The highest prevalence of bony lesions, in terms of tooth involvement, was related to mandibular central incisors (39.45%), followed by mandibular lateral incisors (37.29%). The lowest prevalence was observed in mandibular third molars (6.75%).

The highest prevalence of bony lesions was related to horizontal bone lesions in the anterior mandible, while the lowest prevalence of bone lesions was associated with furcation lesions in the anterior mandible.

Additionally, a significant correlation was observed between the type of periodontal bony lesion and the site of bony lesion occurrence according to the chi-square test ($p < 0.001$). In other words, the prevalence of horizontal bone lesions in the anterior mandible is significantly higher than other bone lesions in all examined areas in the oral cavity (Table 3).

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Table 2. Prevalence of the type of involved teeth based on the involved anatomical areas of jaws

Site of incidence	Posterior mandible		Anterior mandible		Posterior maxilla		Anterior maxilla		Total	
Tooth type	N	%	N	%	N	%	N	%	N	%
Central incisor	0	0	129	39.45	0	0	41	34.75	174	20.59
Lateral incisor	0	0	120	36.70	0	0	44	37.29	168	19.88
Canine	0	0	78	23.85	0	0	33	27.97	110	13.02
First premolar	52	21.94	0	0	27	16.56	0	0	81	9.59
Second premolar	41	17.30	0	0	39	23.93	0	0	81	9.59
First molar	75	31.65	0	0	45	27.61	0	0	111	13.14
Second molar	53	22.36	0	0	35	21.47	0	0	87	10.30
Third molar	16	6.75	0	0	17	10.43	0	0	33	3.91
Total	237	100.00	327	100.00	163	100.00	118	100.00	845	100.00

Table 3. The relationship between the bone lesion type and its site of incidence

Site of lesion / Site of incidence	Vertical		Horizontal		Furcation		Total		P-value
	N	%	N	%	N	%	N	%	
Posterior mandible	22	37.93	163	23.09	52	64.20	237	28.05	0.001*
Anterior mandible	7	120.07	320	45.33	0	0.00	327	38.70	
Posterior maxilla	13	22.41	122	17.28	28	34.57	163	19.29	
Anterior maxilla	16	27.59	101	14.31	1	1.23	118	13.96	

*significant

In Table 4, the areas affected by dental involvement and the type of bony lesion are specified. A significant difference was observed in the prevalence of bone lesions in the posterior mandible based on the type of involved tooth ($p < 0.001$).

However, in other areas with bone lesions, there was no significant difference in the prevalence of bone lesions when considering the involved tooth in that area ($p > 0.05$).

Table 4. The comparative relationship between the type of lesion, the type of tooth, and the site of occurrence.

The site of incidence / tooth type		Lesion Type								P-value
		Vertical		Horizontal		Furcation		Total		
		N	%	N	%	N	%	N	%	
Posterior mandible	First premolar	0	0	22	1.9	0	0	52	21.9	0.001
	Second premolar	2	0.8	39	16.5	0	0	41	17.3	
	First molar	9	3.8	36	15.1	30	12.7	75	33.5	
	Second molar	9	3.8	27	11.4	17	7.2	53	22.4	
	Third molar	2	0.8	9	3.8	5	2.1	16	6.8	
Anterior mandible	Central incisor	3	0.9	126	38.5	0	0	129	39.4	0.051
	Lateral incisor	0	0	120	36.7	0	0	120	36.7	
	Canine	4	1.2	74	22.6	0	0	78	23.9	
Posterior maxilla	First premolar	1	7.69	21	17.21	5	17.86	27	16.56	0.936
	Second premolar	5	38.46	28	22.95	6	21.43	39	23.93	
	First molar	2	15.38	37	30.33	6	21.43	45	27.61	
	Second molar	4	3.77	24	19.67	7	25.00	35	21.47	
	Third molar	1	7.69	12	9.84	4	14.29	17	10.43	
Anterior maxilla	Central incisor	10	62.50	31	31.31	0	0	41	34.75	0.420
	Lateral incisor	4	25.00	40	40.40	0	0	44	37.29	
	Canine	2	12.50	28	28.28	0	0	33	27.97	

*significant

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The most common type of bone lesions, based on the involved tooth, are horizontal bone lesions in the lateral incisors, while the least prevalent are vertical bone lesions in the first premolars. Furthermore, a significant association was observed between the type of periodontal bony lesion and the involved tooth according to the Chi-square test ($p < 0.001$). In other words, the prevalence of horizontal bone lesions in the lateral incisors was significantly higher compared to other bone lesions in other teeth (Table 5).

Table 5. The relationship between the bony lesion type and its site of incidence

Site of lesion / Tooth type	Vertical		Horizontal		Furcation		Total		P-value
	N	%	N	%	N	%	N	%	
Central incisor	13	22.41	161	22.80	0	0	174	20.59	0.001*
Lateral incisor	4	6.90	164	24.22	0	0	168	19.88	
Canine	6	10.34	104	14.73	0	0	110	13.02	
First premolar	1	1.72	75	10.62	5	6.17	81	9.59	
Second premolar	7	12.07	68	9.63	6	7.41	81	9.59	
First molar	11	18.97	64	9.07	36	44.44	111	13.14	
Second molar	13	22.41	50	7.08	24	29.63	87	10.30	
Third molar	3	5.17	21	2.97	9	11.11	33	3.91	

*significant

The most common type of bone lesions, based on the type of restoration, are horizontal bone lesions in teeth with amalgam restorations, while the least common type of bone lesion is associated with vertical and furcation bone lesions in crowns.

Furthermore, a significant association was observed between the type of periodontal bone lesion and the type of restoration according to the Chi-square test ($p < 0.001$). In other words, the prevalence of horizontal bone lesions in teeth with amalgam restorations was significantly higher compared to other bone lesions in other types of restorations (Table 6).

Table 6. The relationship between the periodontal bone lesion type and restoration type

Lesion type / Restoration	Vertical		Horizontal		Furcation		Total		Significance
	N	%	N	%	N	%	N	%	
Composite	2	13.33	3	10.00	2	11.76	7	11.29	0.001*
Amalgam	13	86.67	21	70.00	12	70.59	46	74.19	
Crown	0	0	6	20.00	3	17.65	9	14.52	

*significant

Based on the contact status, the most common type of bone lesions is horizontal bone lesions in open contact, while the least prevalent is vertical bone lesions. Furthermore, a significant association was observed between the type of periodontal bone lesion and the contact status according to the Chi-square test ($p < 0.001$). In other words, the prevalence of horizontal bone lesions is significantly higher compared to other bone lesions in teeth with open contact (Table 7).

Table 7. The relationship between the periodontal bone lesion type and contact status

The site of incidence / Contact	Vertical		Horizontal		Furcation		Total		P-value
	N	%	N	%	N	%	N	%	
Close	18	31.58	294	41.64	40	49.38	663	54.98	0.001*
Open	39	68.42	412	50.62	41	50.62	543	45.02	

*significant

Based on the presence of calculus, the most common type of bone lesions is horizontal bone lesions in teeth with calculus, while the least prevalent is vertical bone lesions. Furthermore, a significant association was observed between the type of periodontal bone lesion and the presence of calculus according to the Chi-square test ($p < 0.001$). In other words, the prevalence of horizontal bone lesions is significantly higher compared to other bone lesions based on the presence of calculus (Table 8).

Table 8. The relationship between the periodontal bone lesion type and plaque

The site of incidence / Plaque	Vertical		Horizontal		Furcation		Total		P-value
	N	%	N	%	N	%	N	%	
Positive	28	49.12	74	10.48	32	39.51	134	15.88	0.001*
Negative (plaqueless)	29	50.88	632	89.52	49	60.49	710	84.12	

*significant

Discussion

Periodontitis is one of the most common chronic inflammatory diseases that can affect individuals of all ages. The main cause of periodontitis is the presence of opportunistic bacteria naturally found in the mouth (16).

Periodontitis is primary cause of tooth loss among adults and is a multifactorial disease influenced by various factors (16). Assessing the risk of developing chronic diseases is of great importance because dental caries and periodontitis are prevalent only among a small group of individuals classified as high-risk individuals.

Gingivitis serves as a precursor to the development of periodontitis and is often a result of plaque accumulation(17).

However, sometimes this inflammation is not caused by common factors like plaque, and it is referred to as plaque-unrelated gingival inflammation. The severity of periodontal disease depends on the extent of biofilm accumulation, invasion by biofilm bacteria, and cellular and humoral responses to biofilm microorganisms (18).

Most of the lesions examined in the current study were horizontal lesions, and the highest prevalence of these lesions was observed in the mandibular anterior region, with the central incisors having the highest frequency. In the present study, the highest prevalence of lesions was observed in the central and lateral incisors, which can be attributed to the presence

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of more plaque and calculus in the mandibular anterior region due to poor oral hygiene and the submandibular salivary gland. However, some reports indicate that the first mandibular molars are the most common site of occurrence, while the maxillary molars are the least common site. In some studies, a higher prevalence has also been reported for the maxillary molars (19-23).

It has also been stated that the presence of lesions increases from anterior to posterior, and the molars in both jaws are among the most affected teeth (23,24). The results of the current study differ from previous studies in terms of the prevalence of lesion sites. The reason for this discrepancy may be attributed to the type of study conducted, the type of images examined, and the specific types of lesions investigated.

In the current study, the highest prevalence of bone lesions based on restoration was related to horizontal lesions in amalgam restorations, while the lowest prevalence was associated with furcation and vertical lesions in composite restorations. Furthermore, a significant association was observed between the type of periodontal bone lesion and the type of restoration, indicating that the frequency of horizontal lesions in amalgam restorations is significantly higher than other lesions in other restorations. Ababnaeh et al. stated in their study that periodontal lesions have the highest prevalence in amalgam restorations (25). Similarly, Collares et al. found that periodontal lesions have a higher prevalence in subgingival and amalgam restorations compared to supragingival and composite restorations (26). Therefore, the results of the current study align with the studies by Ababnaeh et al. and Collares et al., but they differ from the study by Daud et al (27). They found that the mean indices of MGI, PI, BI, and PDI in teeth restored with composite were higher than in amalgam restorations, indicating a significant difference. The discrepancy in the results of the current study and the study by Daud et al. could be due to differences in the study methodology. In their study, they examined the impact of proximity between amalgam and composite restorations in Class II restorations on the periodontal health of patients. Although significant advancements have been made in composite resin restoration technology, amalgam restorations are still used due to their cost-effectiveness and long-term serviceability (28). The most common reasons for replacing amalgam restorations are recurrent caries and restoration fracture (29).

The highest prevalence of bone lesions based on contact status is associated with horizontal lesions in open contact, while the lowest prevalence is related to vertical lesions. Additionally, a significant association is observed between the type of periodontal bone lesion and contact status, indicating that the frequency of horizontal lesions is significantly higher than other lesions in open contact. In a study by Jernberg et al., which examines the relationship between periodontal lesions and open contact in patients, it was concluded that there is a direct and strong correlation between the occurrence of periodontal diseases and open contact in patients. Proper anatomical proximal contact allows for healthy papilla between the teeth, which fills the interdental space and protects the interdental tissues against periodontal disease and prevents food impaction. Therefore, it is evident that the presence of open contact increases the possibility of the spread of periodontal lesions(30).

Khan et al. stated in their study that untreated open contact initially leads to discomfort due to food impaction and microbial plaque accumulation, eventually resulting in furcation lesions of Type II and periodontal disease due to the interdental crestal bone loss(31). Hence, the results of the current study was similar with previous studies, and no reports of a lack of association between open contact and oral lesions were observed.

The highest prevalence of bone lesions based on the presence of calculus is associated with horizontal lesions in teeth with calculus, while the lowest prevalence is related to vertical lesions. Additionally, a significant association is observed between the type of periodontal bone lesion and the presence of calculus, indicating

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that horizontal lesions have a significantly higher frequency compared to other lesions associated with a higher presence of calculus. Various studies have investigated the impact of dental calculus on the occurrence of periodontitis and periodontal lesions(31). In general, the influence of calculus and its increasing amount can be a major factor in the development of periodontal diseases. Levi et al. stated in their study that calculus is a contributing factor to the occurrence of furcation lesions (especially Class II furcation) and horizontal lesions(17). Therefore, the results of the current study align with the study by Levi et al. Based on the findings of the current study, it can be concluded that the most common site of lesion occurrence, based on the type of lesion, is in the mandibular anterior region, specifically in the incisors. Open contact and the amount of calculus are associated with the occurrence of Class II furcation lesions. One of the limitations of the current study is the lack of similar topic-related articles, so the comparison of the study results with previous studies was done on a case-by-case basis, generalizing the findings of the current study with those studies.

Conclusion

Based on the current study, there is a significant association between the type of periodontal bone lesion, tooth involvement, restoration type, contact status, presence of calculus on radiographs, and the site of lesion occurrence in the posterior mandibular region. However, there is no significant association between the type of bone lesion and the site of bone lesion occurrence in other areas.

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None

Authors' contributions

Ashkan Salari: Conceptualization, Methodology, Writing - Review & Editing **Fardin Zarei:** Resources, Investigation, Visualization **Farnoosh Khaksari:** Methodology, Visualization **Reza Delbari:** Writing - Original Draft, Data Curation **Soheil Taghavi:** Funding acquisition, Project administration, Supervision

Conflict of Interests

The authors declare no conflict of interest.

Ethical declarations

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Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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