Clinical and Experimental Health Sciences

Original Article / *Özgün Araştırma*

Assessing the Association Among Smoking, Diabetes Mellitus, and Periapical Status Using Panoramic Radiography

Sigara Kullanımı ve Diabetes Mellitus'un Periapikal Durum ile İlişkisinin Panoramik Radyografi Kullanılarak Değerlendirilmesi

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Abstract

Objective: This retrospective case-control study aimed to investigate the association between smoking and radiographically diagnosed apical periodontitis using panoramic radiographs and periapical index (PAI) scoring system.

Methods: The records of 75 controls and 75 patients from the Department of Oral Diagnosis and Radiology at Marmara University Dental Faculty, Turkey were selected and studied. Inclusion criteria were as follows: patients who were aged >20 years, had at least eight remaining teeth, and agreed to a complete clinical and radiographic examination. The case group comprised patients who had at least one periapical lesion, which was radiographically detectable in a tooth. The control group included patients who had no radiographically defined periapical lesion in any teeth.

Results: In this retrospective case-control study, no statistically significant association was observed between smoking and periapical status (p>0.05). In addition, there was no significant association between diabetes mellitus and apical periodontitis in both control and case groups (p>0.05).

Conclusion: As a result, no significant association was found among smoking, diabetes mellitus, and the presence of radiographically detected periapical lesions in this study.

Keywords: Smoking, panoramic radiography, periapical lesion, diabetes mellitus

Öz

Amaç: Bu retrospektif vaka-kontrol çalışmasının amacı sigara kullanımı ve radyografik olarak tanısı konulmuş apikal periodontitis arasındaki ilişkinin panoramik radyografi kullanılarak Periapikal İndeks skorlama sistemi (PAI) ile değerlendirilmesidir.

Yöntemler: Çalışmada 75 vaka ve 75 kontrol hastalarına ait kayıtlar Marmara Üniversitesi Oral Diagnoz ve Radyoloji bölümüne ait arşivden elde edilmiştir. Çalışmaya alınma kriterleri arasında hastaların 20 yaşından büyük olmaları, en az 8 dişe sahip olmaları ve tam bir klinik ve radyografik muayeneyi kabul etmeleri bulunmaktadır. Vaka grubunu en az bir dişinde radyografik olarak tespit edilebilen periapikal lezyona sahip hastalar oluşturmaktadır. Kontrol grubunda ise hastaların hiçbir dişinde periapikal lezyon tespit edilmemiştir.

Bulgular: Bu çalışmada periapikal lezyon varlığı ve sigara kullanımı arasında istatistiksel olarak anlamlı bir ilişki bulunmamaktadır (p>0,05). Ayrıca diabetes mellitus ve periapikal lezyon mevcudiyeti açısından her iki grup arasında anlamlı bir ilişki görülmemiştir (p>0,05).

Sonuç: Sonuç olarak çalışmada sigara kullanımı ve diabetes mellitus ile radyografik olarak tespit edilen periapikal lezyonlar arasında anlamlı bir ilişki saptanmamıştır.

Anahtar kelimeler: Sigara kullanımı, panoramik radyografi, periapikal lezyon, diabetes mellitus

INTRODUCTION

Panoramic radiography visualizes the whole maxillofacial region on a single film (1). At various institutions and clinics, panoramic radiography has been used for regularly screening patients because it enables the examination of dentition, alveolar bone, temporomandibular joints, and adjacent structures (2, 3). Dental radiographic imaging is an important tool for an accurate diagnosis. Traditional radiographs, such as periapical and panoramic radiography, provide adequate information, despite these radiographic modalities only providing a two-dimensional representation of three-dimensional structures. Their limited film size, magnification, image distortion, and 2D view restrict their use in some cases (4).

Tobacco smoking is considered to be a probable risk factor for apical pathology. However, an association between tobacco smoking and apical lesion is controversial because of (a) the different radiographic techniques used for assessments, (b) the assessment of apical lesions itself, and (c) smoking characteristics.

Kirkevang et al. (5) reported for the first time an epidemiological study demonstrating the association between apical periodontitis and tobacco smoking, thereby suggesting that a delay in periapical healing might provoke a higher prevalence of apical periodontitis in smokers. The periapical radiographs in their study were assessed using the periapical index (PAI) scoring presented by Orstavik et al. (6) in 1986. Since then, several studies have analyzed the potential association between smoking and endodontic variables (7-9). However, more studies, such as a case control and more number of patients, are required to make definite conclusions.

Diabetes mellitus is a chronic disease with crucial long-term complications. It mainly causes delayed healing and compromised im-

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mune responses (10). Although the association between diabetes mellitus and periodontal diseases has been frequently evaluated, the progression and healing of periapical lesions in patients with diabetes mellitus have not been completely studied in the literature. It is usually assumed that endodontic infections cause periapical lesions, which are often asymptomatic and are exceptionally prevalent (11). An analysis showed that diabetic patients have a reduced success of root canal treatment in cases with periapical lesions (12).

This retrospective case-control study aimed to assess the association between tobacco smoking, diabetes mellitus, and radiographically diagnosed apical periodontitis using panoramic radiographs.

METHODS

This study was approved by the Marmara University, Faculty of Medicine, Clinical Research Ethical Committee, Istanbul, Turkey (04.12.2015, 09.2015.353/70737436-050.06.04-). The records of 75 controls and 75 patients were selected from the pool of patients in the Department of Oral Diagnosis and Radiology at the Marmara University Dental Faculty, Turkey. The samples were from screened images that were taken from January 2012 to October 2013. Each subject was asked to sign a consent form. The inclusion criteria were as follows: patients who were aged >20 years, who had at least eight remaining teeth, and who agreed to a complete clinical and radiographic examination. The verification of tobacco use was assessed and recorded formerly during clinical examinations, which included a detailed anamnesis form. Patients were defined as nonsmokers if they answered "no" to the question asked "Have you ever smoked?" whereas, patients who answered "yes" to the question were classified as smokers. Patients were also asked if they had diabetes mellitus and/or if they were currently taking any medications.

The case group included patients who had at least one periapical lesion, which was radiographically detectable in a tooth. The control group included patients who had no radiographically defined periapical lesion in any teeth.

Panoramic images were obtained from the Department of Oral Diagnosis and Radiology, Marmara University Faculty of Dentistry archives. All projections were performed with the same radiographic devices (Morita Veraviewpocs model 550; Kyoto, Japan) with a maximum kV of 80, mA=12, and 17-inch monitor (TFT LCD, Global Opportunities). All panoramic radiographs in the study were processed by the same technician. The images were exported and saved as JPEG files.

One observer, who had 3 years of clinical experience in dental radiology, examined all the radiographic images that were obtained using panoramic radiography. The samples were assessed using the PAI scoring system. According to this index, each tooth is categorized as having a normal periapical structure (1) (Figure 1), small changes in bone structure (2) (Figure 2), changes in bone structure with some mineral loss (3) (Figure 3), periodontitis with well-defined radiolucent areas (4) (Figure 4), or severe apical periodontitis with exacerbating features (5) (Figure 5).

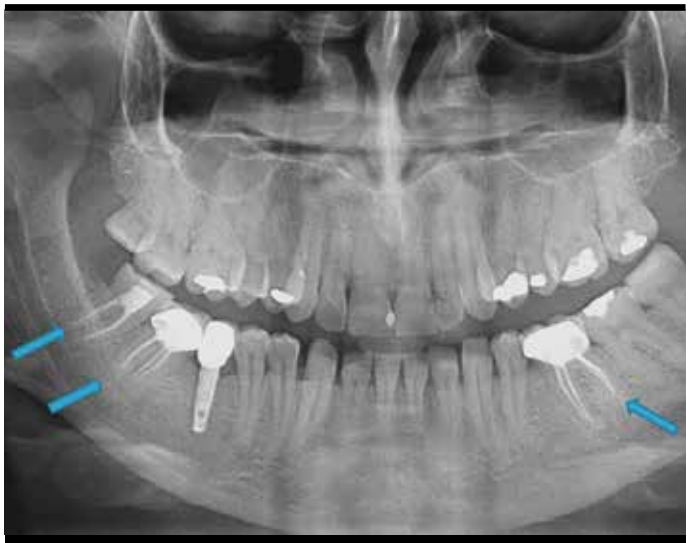

Figure 1. Normal periapical structure (PAI:1)

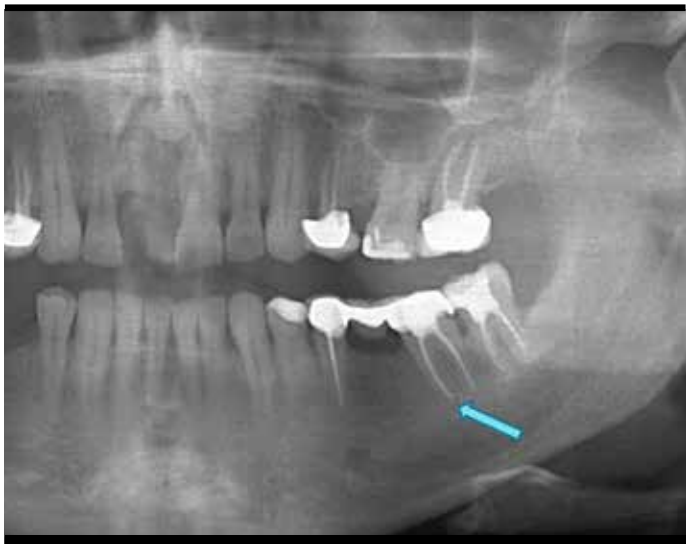

Figure 2. Small changes in bone structure (PAI:2)

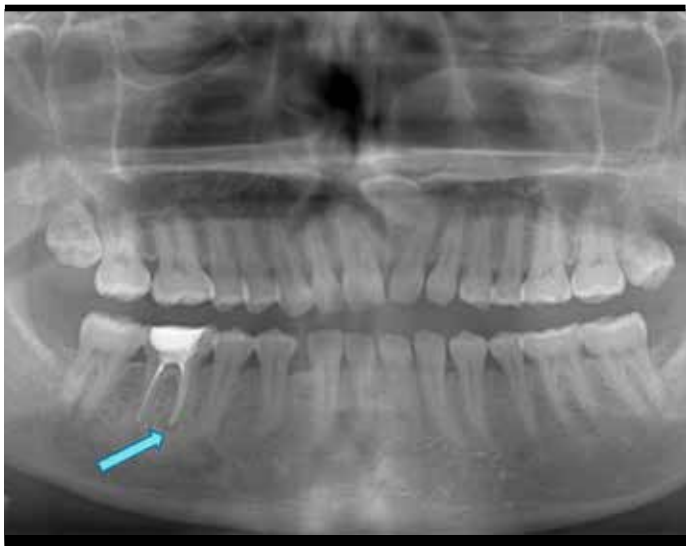

Figure 3. Changes in bone structure with some mineral loss (PAI:3)

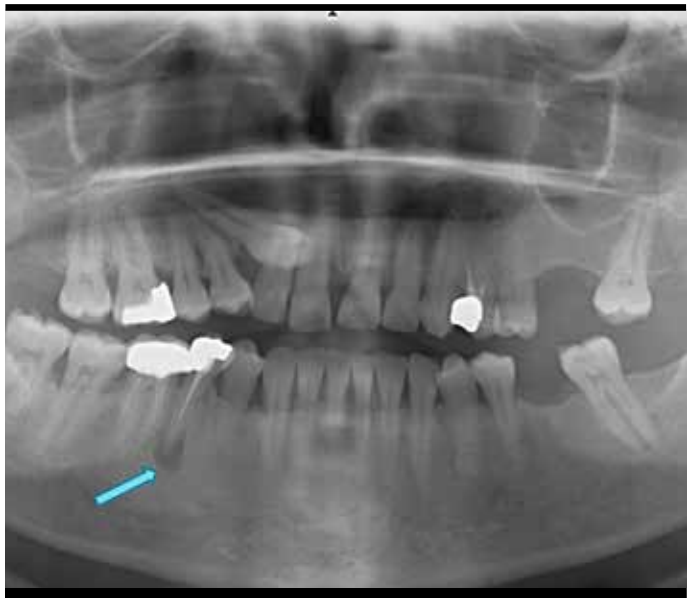

Figure 4. Periodontitis with well-defined radiolucent areas (PAI:4)

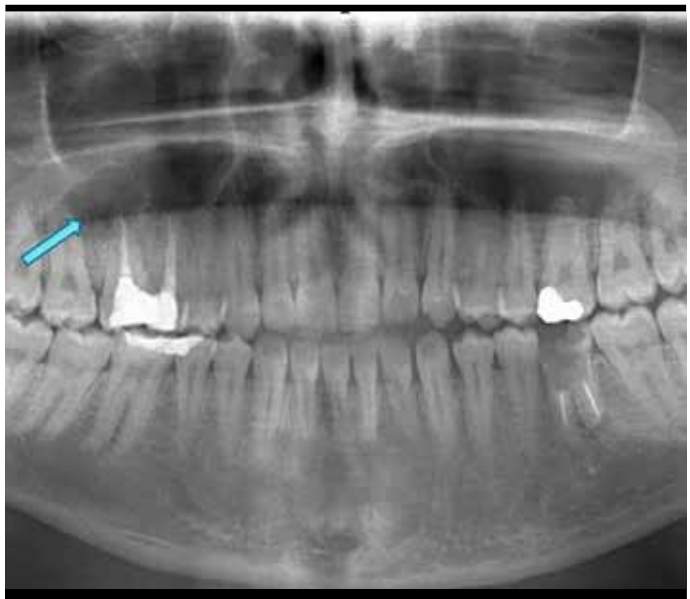

Figure 5. Severe apical periodontitis with exacerbating features (PAI:5)

Statistical Analysis

Statistical analysis was done by using SPSS (Statistical Package for Social Sciences, IBM Corp.; Armonk, NY, USA) software for Windows 15.0. The suitability of the parameters for normal distribution was evaluated by the Kolmogorov–Smirnov test. The Student t test was used with the descriptive statistical methods (mean, standard deviation) as well as in quantitative data comparisons between the two groups of parameters in the normal distribution. The Mann–Whitney U test was used in the comparison of parameters that did not show a normal distribution between the two groups. Qualitative data comparison was done with chi-square and Fisher's Exact chi-square tests. Logistic regression analysis was used for the evaluation of the factors affecting the periapical lesion. The significance level was set at $p<0.05$.

Table 1. Evaluation of parameters according to the sample groups

	Case	Control	p
[1]**Age**, Mean±SD	34.84±10.79	31,02±9.24	0.021*
[2]**Number of teeth,** Mean±SD (Median)	25.88±5.60 (27)	27.37±5.38 (30)	0.069
[2]**No of teeth with lesion,** Mean±SD (Median)	2.40±2.09 (2)	0±0 (0)	0.001**
[3]**Gender** (n; %)			
Male	37 (49.3%)	38 (50.7%)	0.870
Female	38 (50.7%)	37 (49.3%)	
[3]**Smoking** (n; %)			
Yes	41 (54.7%)	36 (48.0%)	0.414
No	34 (45.3%)	39 (52.0%)	
[4]**Diabetes Mellitus** (n; %)			
Yes	5 (6.7%)	1 (1.3%)	0.209
No	70 (93.3%)	74 (98.7%)	

[1]Student t-test [2]Mann–Whitney U test [3]Chi-square test [4]Fisher's Exact Test
*p<0.05, **p<0.01

RESULTS

The study sample included 150 subjects, 75 males (50%) and 75 females (50%), aged 20–67 years, and who were under routine dental care at the Department of Oral Diagnosis and Radiology at Marmara University Dental Faculty, Turkey. The mean age was 32 .93±10. 19 years.

The average age of the patients in the case group was significantly higher ($p<0.05$). According to the number of teeth present in the mouth, there was no statistically significant difference ($p>0.05$) between the groups. When compared with the control group, the number of teeth with lesion in the case group showed a significantly higher percentage ($p<0.01$). The were no significant differences between male and female samples in the study conducted ($p>0.05$). Smoking rates among patients in the groups did not portray any statistically difference ($p>0.05$). The smoking rates in the case and control groups were 54.7% and 48%, respectively.

Moreover, there was no significant association between diabetes mellitus and apical periodontitis ($p>0.05$). 6.7% of the patients in the case group and 1.3% of the patients in the control group had diabetes. According to the evaluation of the number of teeth with periapical lesion related with smoking, no statistically significant difference was reported in both genders, i.e., female and males ($p>0.05$). Likewise, when the number of teeth with lesion related to the presence of diabetes mellitus was evaluated, as Table 1 shows, there was no significant difference in both female and male samples (Table 1).

The distribution of PAI scoring in Table 2 reveals that 14.7% of the samples in the case group showed normal periapical structures and 20.0% of the samples had small changes in bone structure. It was reported that in 21.3% of the samples, changes in the bone structure with some mineral loss were observed, while 32.0% of the samples

Table 2. Distribution of PAI scoring in the case group

Case	PAI
	n (%)
1	11 (14.7%)
2	15 (20.0%)
3	16 (21.3%)
4	24 (32.0%)
5	9 (12.0%)
PAI: Periapical index	

Table 3. Logistic regression analysis of factors affecting the periapical lesion

		B	S.E	p	OR	%95 CI for OR	
						Lower	Upper
Step 1	**Age**	0.036	0.018	0.044*	1.037	1.001	1.074
	Gender (Male)	0.121	0.346	0.726	1.129	0.573	2.224
	Smoking (Yes)	−0.272	0.336	0.418	0.762	0.394	1.471
	Diabetes Mellitus	−1.256	1.131	0.267	0.285	0.031	2.613
	Constant	0.103	1.369	0.940	1.109	-	-
Step 2	**Age**	0.035	0.017	0.046*	1.035	1.001	1.071
	Smoking (Yes)	−0.269	0.336	0.423	0.764	0.396	1.475
	Diabetes Mellitus	−1.267	1.130	0.262	0.282	0.031	2.580
	Constant	0.223	1.326	0.866	1.250	-	-
Step 3	**Age**	0.034	0.017	0.049*	1.034	1.000	1.070
	Diabetes Mellitus	−1.307	1.127	0.246	0.271	0.030	2.464
	Constant	0.152	1.320	0.908	1.165	–	
Step 4	**Age**	0.038	0.017	0.024*	1.039	1.005	1.074
	Constant	−1.256	0.577	0.030	0.285	-	-

in the case group had periodontitis with a well-defined radiolucent area. Severe periodontitis with exacerbating features were also affirmed in 12% of the samples in our study (Table 2).

When the effects of age, gender, smoking, and diabetes mellitus parameters on periapical lesions were evaluated with Backward Stepwise Logistic Regression analysis, the general pattern was not found to be statistically significant ($p>0.05$). The Negelkerke R square value of the model was 0.047 and the explanatory coefficient was found to be 60.7%. Although the overall model was not significant, the effect of age in the model was statistically significant, and it has been shown that age had a 1,039 times enhancing effect on periapical lesions ($p<0.05$) (Table 3).

DISCUSSION

Apical periodontitis is primarily induced by infection of the root canal system (13). Deviations from the normal periapical bone anatomy, as portrayed by radiography, promote the diagnosis of apical periodontitis (14). The aim of our study was to examine the association between tobacco use, which is cigarette smoking, and radiographic periapical status by using panoramic radiography in a case-control study form. Our study results indicate that there was not a statistically significant association between tobacco smoking and the presence of radiographically diagnosed periapical lesions. There were no significant differences between the control and case groups with respect to age or gender because the control subjects were age and sex matched with the case patients. Moreover, further similarity was stated in terms of the average number of teeth per patient in both groups.

Previous studies involved numerous radiographic techniques to reveal the presence of AP using PAI (15-17). Radiographs are very useful for identifying dental diseases, such as periapical lesions, when compared with clinical examination. Lee et al. (18) found 11.9% of periapical lesions in their study in which they screened panoramic radiographs as a radiographic technique. In addition, Rushton et al. (19) reported 40.2% of apical periodontitis when screening panoramic radiographs.

The PAI scoring system has been used for the evaluation of apical periodontitis in many studies (20-22). It is noted that panoramic radiographs have a diagnostic sensitivity reaching 86-96% and involves lower patient radiation doses when compared with the full mouth series of periapical radiographs (23). Panoramic radiography also a showed higher percentage of teeth with PAI score of ≥3 in various studies (24). However, it has also been reported that an underestimation of lesions occurred when panoramic radiography was used as a radiographic method (25, 26). Likewise, it has been indicated that in detecting endodontic pathologies, periapical radiographs show superior accuracy when compared with panoramic radiographs (27, 28).

As Johnson et al. (29) and Labriola et al. (30) revealed in their studies tobacco smoking is an important risk factor in inflammation of the periodontium. It may be estimated that it would have a correlative effect on the apical periodontium (7, 16). Kirkevang et al. (5) were the first authors to suggest an association between smoking and periapical lesions when they presented a radiological study that they conducted in Denmark in which 613 patients were asked to take a radiographic examination in order to evaluate risk factors related with apical lesions. The radiographs were evaluated using PAI and the results were presented in 1986 by Ørstavik et al. (6), and it was

stated therein whether apical periodontitis was present or not. A lack of dental care and deficient coronal fillings as well as smoking were statistically related with apical lesions. However, the association was not significant and the study had an attendance rate of 51%, which is a factor that may cause bias in the results. However, the same association was also reported by Aleksejuniene et al. (31).

Several authors have mentioned smoking as "a risk indicator" for apical lesions. Bergstrőm et al. (8) retrospectively evaluated 247 intraoral radiographs of nonsmokers, smokers, and former smokers, and compared them for the incidence of apical lesion and studied the association between apical periodontitis and smoking. The results revealed that the mean number of periapical lesions was 3% in nonsmokers, 6% in smokers, and 4% in former smokers, and it was reported that there was no evidence of an association between apical periodontitis and smoking. There is conflicting evidence related to smoking and the incidence of periapical lesions and as to whether tobacco smoking causes an increase in the prevalence of apical periodontitis. Longitudinal studies are required to make distinct conclusions (9).

The healing of lesions in diabetic patients is rarely studied in literature. The body's responses to infection are reduced by smoking (32-34). It was reported in a study that in diabetic conditions, inflammatory periapical reactions are usually seen more often, and when the inflammation becomes exacerbated, a rise in blood glucose occurs, resulting in an uncontrolled diabetic state. It is also proposed that periapical lesions do not heal easily if diabetes is not controlled, and that the lesions will increase in size regardless of endodontic treatment (35). Falk et al. (36) published a clinical and radiographic investigation, which stated that in type 1 diabetics, the prevalence of periapical lesions is higher. Another study revealed that diabetic patients had a high percentage of pulpal infections (37). In addition, a cross-sectional study conducted in Brazil, evaluated endodontic treatment in type 2 diabetic and nondiabetic individuals in the Brazilian population. It was found that in type 2 diabetics, AP was significantly more prevalent (38). Also, the chronic periapical disease may lead to a diabetic state, as stated in the results of some studies. However, our study indicates that there is no evidence for the association between these two variables. Further epidemiological studies are required to examine the association between periapical lesions and diabetes mellitus.

CONCLUSION

The objective of this case-control study was to investigate the association between tobacco smoking, diabetes mellitus, and periapical status using an index related to panoramic radiography. An association between these parameters and the presence of periapical lesions was not found in this retrospective study.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Marmara University Faculty of Medicine, Clinical Research Ethical Committee (04.12.2015, 09.2015.353/70737436-050.06.04-).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author contributions: Concept - F.P.; Design - G.K., F.P.; Supervision - F.P.; Resource - G.K., F.P.; Materials - G.K., F.P.; Data Collection&/or Processing - G.K.; Analysis&/or Interpretation G.K.; Literature Search - G.K., F.P.; Writing - G.K.

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Hakem Değerlendirmesi: Dış Bağımsız.

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