



(RESEARCH ARTICLE)



Risk indicators of apical periodontitis in an adult Sudanese population

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Abstract

Endodontic and periapical status are significant restraints that can predict tooth existence and the potential necessity for dental treatment in the growing dental population. The aim of this study is to estimate risk indicators for apical periodontitis (AP) in an adult Sudanese patients. This is an observational cross-sectional hospital-based study. Clinical and radiographical examination of 200 patients above 18 years seeking routine dental management for the first time at the dental clinics (University of Khartoum) and the Dental Hospital (University of Science and Technology) was performed. The clinical examination included history and intra oral examination of coronal and periodontal status of each individual tooth. Data were assessed using the chi-square test and odds ratio at significant level of 5% and confidence level of 95%. Radiographs revealed that 624 teeth (48.7% in the maxilla; 51.3% in the mandible) were lost leaving a total of 4967 teeth to be examined. AP was found in 95 patients (47%) and 3.3% of the teeth. A remarkably increased risk for AP was detected in teeth with root fillings, specifically technical inadequate ones (OR = 4.30, P<0.05). Presence of remaining root, coronal restoration, inadequate restoration and lost restoration also increased the risk for AP (P<0.001). Teeth with mobility and probing pocket depth of more than 4 mm were also associated with AP. Therefore, the main risk indicators of AP were the high plaque percentage, radiographic evidence of root fillings, the incidence of numerous carious lesions and the inappropriateness of dental treatment.

Keywords: Risk-Indicators; Apical Periodontitis; Adult Population; Root filled teeth

1. Introduction

AP is an acute or chronic inflammatory process around the apex of a tooth root; it results from microbial infection of the teeth root canals. It is a wide spread disease with an obvious cumulative economic impact, especially when we consider the cost and training need for its only viable treatment which is root canal treatment or retreatment [1-7]. Diagnosis of AP necessitates evaluation of the patient's symptoms and signs. However, the majority of AP cases are asymptomatic, so the diagnosis is based mainly on the radiographic examination [8].

A parameter is described as a 'risk indicator' when its occurrence increases the individual's risk of demonstrating the disease. Risk indicators might be directly linked with the disease [9]. Identification of individual risk indicator could help in selection of patients/ or teeth for extra radiographic examination. Numerous prior studies have tried to detect risk indicators of AP. It has been concluded that the presence and adequacy of the root canal filling, [1,10,11,12,13] the quality of the coronal restoration, [14,15] decayed and filled teeth, [1,3,16] were related with the presence of AP [15]. Results from western populations have revealed that age, smoking, presence of diabetes mellitus type II, and the frequency of dental visits, were associated with the existence of AP as well [17,18,19,20,21]. The objective of this study is to identify some risk indicators for AP in an adult Sudanese population in Khartoum State. This may be a valuable estimate in the development of under and postgraduate dental education.

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2. Material and methods

2.1. Study Population

The sample included 200 adult patients seeking routine dental care and attending the dental clinics at the Faculty of Dentistry (University of Khartoum) and the Dental Hospital at the (University of Science and Technology).

The inclusion criteria in the study were that only patients attending for the first time were involved. Patients under 18 years, pregnant ladies and patients with less than 7 remaining teeth were not included.

2.2. Ethical Approval

The research protocol was approved by the ethical committee of the dental faculty; University of Khartoum. All participants signed a written informed consent.

2.3. Clinical Examination

All patients were clinically and radiographically examined. For each patient, a history and examination form has been filled recording the following information: - age, gender, oral hygiene practice, Diabetes mellitus history, sum of remaining teeth (not including third molars), smoking history and frequency of dental visits. Plaque accumulation percentage was also estimated by dividing the sum of plaque containing surfaces by the total number of available surfaces. For each tooth, the following data has been collected:

2.3.1. The coronal status

- Decayed Tooth (Primary or Secondary Carious Lesions).
- Tooth with Intra or Extra Coronal Restoration.
- Tooth with Inadequate or Lost Restoration.

2.3.2. The Periodontal status

- Bleeding on Probing percentage: was estimated by dividing the sum of gingival bleeding surfaces by the entire number of available surfaces.
- Probing Pocket Depth in mm: The pocket was estimated at 6 points on each tooth (mesio-buccal, mid-buccal, disto-buccal, and the equivalent lingual sites).
- Gingival recession was also measured as the distance of the free gingival margin to the cemento-enamel junction.
- Attachment Loss in mm: Clinical attachment loss is the distance from the cemento- enamel junction to the apical extent of the pocket.
- Tooth Mobility: Mobility was estimated by moving the teeth in a bucco-lingual and occluso-apical direction. Minor mobility, beyond that which is physiological, was graded as I. If the mobility is slightly more but the tooth cannot be depressed apically in the alveolus, it was recorded as II. If the mobility is advanced to the degree that the tooth may be depressed apically, it was scored as III.
- Furcation involvement: The extension of pockets into furcations was graded according to the following classification: Degree I; incipient or early supra bony pocket extension into the furcation area with slight loss of bone Degree II; extension of the pocket into the furcation leaving a portion of the alveolar bone and periodontal ligament intact allowing only partial penetration of the probe into the furcation area; Degree III; through and through extension of the pocket into the furcation area. All teeth have been recorded according to FDI nomenclature.

2.4. Radiographic Examination

A combination of panoramic and peri-apical radiographs was taken by a dental experienced radiologist, using Cranex 3+ Ceph (Sore dex orion corporation, Finland) X ray unit and Kodak (MXG and Dental Intra oral E- speed) films (Estman Kodak Company, Rochester New York USA). The prei-apical radiograph has been taken when the tooth apical area was not clear on the panoramic view. The paralleling technique was used for taking the peri-apical radiographs (using Endo Ray II film holder, Dentsply Rinn Corporation USA). An experienced dental assistant processed the films manually.

2.5. Radiographic Evaluation

From the radiographic examination, all teeth excluding third molars were graded according to the FDI nomenclature. Teeth have been categorized as;

- Normal: No periapical radiolucency and normal width of periodontal ligament space.
- Endodontically treated: A tooth with a radio-opaque material in the root canal.
- Apical Periodontitis: A tooth with distinct periapical radiolucency or widening of the periodontal ligament space exceeding two times the normal width.
- Multi-rooted teeth were classified according to the root displaying the most severe periapical radiolucency.

The following information were recorded in a structured form for each patient

- Number and location of teeth without root filling having identifiable AP.
- Number and location of teeth with root filling having identifiable AP.
- Number and location of RF teeth.
- Satisfactory length extension of root filling: filling material present in the root canal within 0-2 mm of the radiographic apex.
- Unsatisfactory length extension of root filling: filling material present in the root canal more than 2 mm from the radiographic apex (shorter or extruded beyond the apex).

2.6. The main investigator

The radiographs were examined by one observer (Ahmed, I.) assisted by an experienced radiologist, under standardized situations using consistently illuminated viewing box.

2.7. The intra-observer reproducibility

This was evaluated by a double scoring of randomly selected 50 patients. The intra-observer agreement test estimated a Cohen's Kappa value of 0.951.

2.8. Data analysis

The Statistical Package for social Sciences (SPSS) version 15 was used for data management. The data was then transferred to the software of the Epidemiologic Perspectives and Innovation programme (PEPI-for-Windows).

Data was analysed using the chi-square test and odds ratio. P- value less than 0.05 was considered as significant.

3. Results

Age of the 200 participants varied from 18 to 75 years with a mean \pm SD age of 34.0 ± 12.9 years. Most of the study population were females (76.5%). Not including the third molar teeth, 624 (12.5%) teeth were lost (48.7% in the maxilla; 51.3% in the mandible). The number of missing teeth ranged from 1- 16 per patient, with an average of 1- 2 teeth per patient.

3.1. Periapical Status

The periapical status of 4976 teeth was estimated, with a range of 12-28 teeth per patient. Ninety-five (47.5%) patients had AP in one or more tooth (range 1-7). A total of 163 (3.3%) teeth had AP.

3.2. Coronal Status

Of the 4976 teeth included in the study, 3951 (79.4%) teeth were intact, 255 (5.1%) teeth had a restoration and 595 (11.6%) carious teeth (Table 1). Sixty five percent of the decayed teeth had AP while AP has been found in 0.32% of sound teeth.

3.3. Periodontal Status

The plaque accumulation was more than 20% in 95(47.5%) patients (Figure 1). There was no bleeding on probing in 133 (66.5%) patients, less than 20% bleeding in 58 (29.0%) patients and more than 20% in 9 (4.5%) patients. There were 4912 (98.7%) teeth with normal mobility and 64 (1.3%) teeth with mobility. The probing pocket depth was ≤ 3

mm in 981 (81.75%) teeth and from 4-6 mm in 202 (16.8%) teeth. There was no attachment loss in 1063 (88.6%) teeth and from 1-4 mm loss in 78 (6.5%) teeth. About 6 percent of molar teeth have furcation involvement.

Table 1 Number and percentage of teeth with AP according to coronal status.

	Apical periodontitis (%)	Normal (%)	Total (%)
Intra-coronal restoration	8 (4.9)	186 (3.9)	194 (3.9)
Extra-coronal restoration	7 (4.3)	54 (1.1)	61 (1.2)
Lost restorations	12 (7.4)	15 (0.3)	27 (0.5)
Inadequate restoration	18 (11.0)	62 (1.3)	80 (1.6)
Decayed root	44 (27)	24 (0.5)	68 (1.4)
Caries	65 (39.9)	530 (11.0)	595 (11.6)
Intact	9 (5.5)	3942 (81.9)	3951 (79.4)
Total	163 (3.3)	4813 (96.7)	4976 (100)

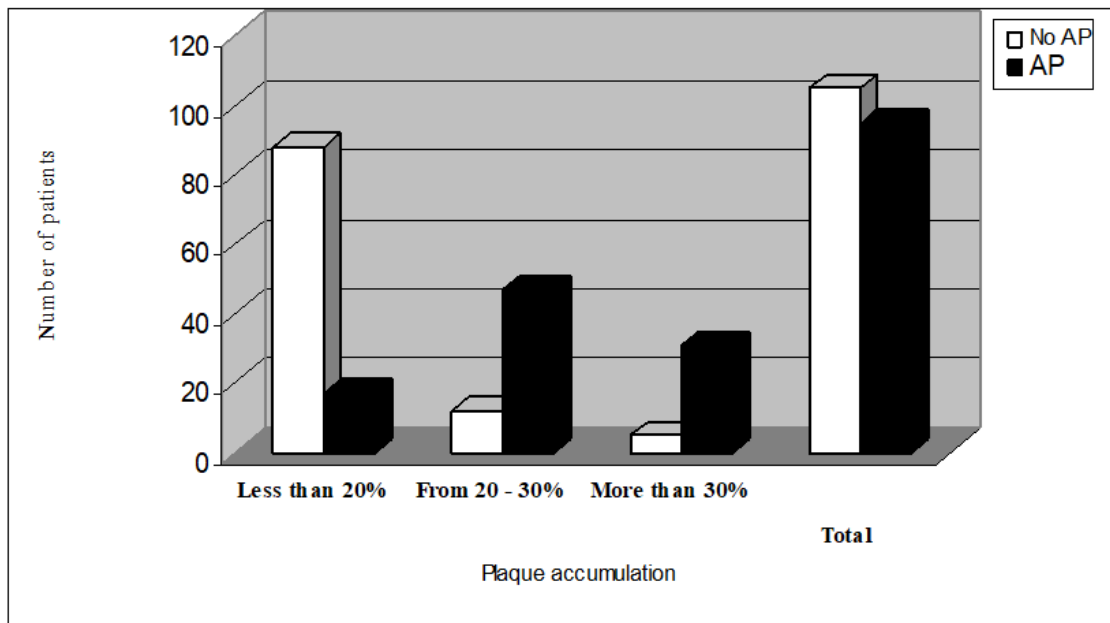


Figure 1 Distribution of the patients according to the plaque accumulation percentage

3.4. Endodontic Treatment

Seventy nine percent of the patients had no root fillings, while 21 % had ≥ 1 root filled teeth (range 1-6). Of the patients with root fillings, 25 (59.5%) had AP, whereas 70 (44.3%) of the patients without root fillings had AP. A total of 80 (1.6%) teeth had been root filled. Of these root-filled teeth 26 (32.5%) teeth had AP.

3.5. Risk Indicators of AP

The main aim of the statistical analyses was to identify the best predictive factors for having AP in patients and teeth. Tables 2 and 3 show the odds ratio (OR) with 95% confidence interval (CI) and P- value for estimation of the statistical association between the possible risk indicators and the outcome variable (AP/ no AP).

Risk Indicators of AP / patients: The prevalence of teeth with AP increased with age (Table 2). The first three age groups (18- 47 years old) had a prevalence of teeth with AP between 2 and 4%, though, the prevalence in the older groups (≥ 48 years old) was higher (6%) (OR =2.46, P >0. 001). The probability of AP in males was twice that in females

(OR= 2.35, P<0.05). An exceedingly increased risk for AP was detected in patients with plaque accumulation of more than 20% (OR = 19.22 – 28.96, P<0.001). Ninety seven percent of the patients used tooth brush as an oral hygiene tool, while 3% used siwak. Among the study patients, 6 patients (3%) were diabetic and 8 patients (4%) were smokers. Most of the patients (98.5%) were irregularly visiting the dentist. Patients with more than 4 missing teeth were significantly associated with having AP (OR = 2.36, P< 0.05) (Table 2).

Risk Indicators of AP / teeth. An extremely increased risk for AP was seen in teeth with coronal restoration, inadequate restoration, lost restoration and remaining roots (P < 0.001). A statistically significant difference was found between AP and teeth with mobility (P <0.001) (Table 3). Presence of probing pocket depth of more than 7 mm also increased the risk for AP (P<0.05) (Table 3). Inadequate root canal fillings were found in seventeen (65.38%) of root-filled teeth with apical periodontitis. Most of them being short of the radiographic apex. There was a statistically significant relationship between the adequacy of root fillings and the existence of AP (P < 0.05). The probability of AP in teeth with unsatisfactory root fillings length was four times that in teeth with satisfactory root fillings (OR= 4.30).

Table 2 Risk indicators of AP for patients

Variables	Category	Adjusted OR	95% CI	P- value
Age	18-27 (n = 73)	1.00	-	-
	28-37 (n = 55)	0.83	0.37 - 1.85	0.755
	38-47 (n = 38)	2.56	1.08 - 6.35	0.030
	48-57 (n = 21)	6.58	1.99 - 28.67	0.001
	58+ (n = 13)	5.07	1.27 - 28.18	0.018
Gender	Female (n = 153)	1.00	-	-
	Male (n = 47)	2.35	1.16 - 4.97	0.017
Smoking	No (n = 192)	1.00	-	-
	Yes (n = 8)	1.78	0.38 - 10.30	0.613
History of diabetes mellitus	No (n = 194)	1.00	-	-
	Yes (n = 6)	4.27	0.64 - 134.47	0.167
Oral hygiene practice (frequency)	1/ day (n = 97)	1.00	-	-
	2/day (n = 79)	0.64	0.34 - 1.22	0.191
	More than 2/day (n = 24)	1.10	0.42 - 2.98	0.998
Oral hygiene practice (tool)	Tooth brush (n = 194)	1.00	-	-
	Siwak (n = 6)	4.23	0.64 - 133.20	0.171
Plaque accumulation %	Less than 20% (n = 105)	1.00	-	-
	From 20-30% (n = 59)	19.22	8.34 - 50.52	< 0.001
	More than 30% (n = 36)	28.96	9.97 - 110.76	< 0.001
Bleeding on Probing %	No bleeding (n = 133)	1.00	-	-
	From 1-20% (n= 58)	0.59	0.30 – 1.15	0.128
	More than 20% (n= 9)	1.17	0.26 – 5.59	1.00
Number of missing teeth	0 (n = 61)	1.00	-	-
	1-3 (n = 68)	1.30	0.61 - 2.81	0.576
	4+ (n = 71)	2.36	1.12 - 5.14	0.022

Table 3 Risk indicators of AP for teeth

Variables	Category	Adjusted OR	95% CI	P- value
Mobility	Normal (n = 4912)	1.00	-	-
	Degree I (n = 31)	6.52	2.01 - 16.90	< 0.001
	Degree II and III (n = 33)	8.90	3.058 - 20.463	< 0.001
Probing pocket depth	<=3 mm (n = 981)	1.00	-	-
	4-6 mm (n = 202)	2.01	1.28 - 3.11	0.002
	7+ mm (n = 17)	4.18	1.19 - 12.51	0.020
Attachment loss	No loss (n = 1063)	1.00	-	-
	1-4 mm (n = 78)	1.01	0.42 - 2.13	1.000
	5+ mm (n = 59)	1.99	0.92 - 3.97	0.090
Furcation involvement	No (n = 374)	1.00	-	-
	Degree I (n = 11)	3.06	0.70 - 11.61	0.185
	Degree II (n = 8)	1.96	0.23 - 9.67	0.862
	Degree III (n = 7)	3.96	0.66 - 21.00	0.177
Coronal status	Intact (n = 3951)	1.00	-	-
	Caries (n = 595)	51.24	25.69 - 116.2	< 0.001
	Intra coronal restoration (n = 194)	18.84	6.233 - 55.579	< 0.001
	Extra coronal restoration (n = 61)	57.11	17.173 - 177.245	< 0.001
	Inadequate restoration (n = 80)	122.84	51.389 - 331.514	< 0.001
	Lost restorations (n = 27)	334.68	116.27 - 1081.62	< 0.001
Root filling	Decayed root (n = 68)	753.78	331.94 - 2003.54	< 0.001
	Not present (n = 4896)	1.00	-	-
	Present (n = 80)	16.83	9.86 - 28.25	< 0.001
Length of the root filling	Satisfactory length (n = 47)	1.00	-	-
	Unsatisfactory length (n = 33)	4.30	1.49 - 13.83	0.005

4. Discussion

In Sudan, full dental radiographs are not usually included in routine patients' examination requirements. The aim of this study is detecting risk indicators that could help the general dental practitioner in recognizing individuals with a high risk for AP. It also concentrated on information assumed to be existing to the dentist through patients' history and examination. The present study clearly indicated that age, more than 20% plaque and more than 4 missing teeth were the best indicators for AP in the individual. AP is frequently a consequence to dental caries, which increases in older individuals. The plaque forms a source of bacteria, which could migrate to the apical tissue through decayed teeth or lateral periodontal ligament space [22,23]. The presence of bacteria and their antigens stimulate the immune system to form a granulation tissue around the apical area. Local immune response eliminates excess numbers of invading organisms. However, in parallel with protective reactions, local activity of immunocompetent cells and their soluble products also contribute to tissue damage, bone resorption and perpetuation of inflammation [24-27]. The missing teeth are more likely to have disease before extraction than present teeth [28]. This study also aimed at identification of teeth with a high risk of having AP. It was revealed that the existence of a root filling extremely increased the risk of AP in the tooth (OR= 16.83). The prevalence of AP in root-filled teeth was 32.5%, which is comparable with other studies that ranged from 25.6% to 35.6% [1,2,12,29,30,31,13].

It has been proposed previously that, the choice of endodontically treated teeth for radiographic examination is effective in the detection of periapical lesion [32,33,9]. This study results support this findings. Endodontic accomplishment is based on three essential issues: cleaning, shaping and filling. On radiographs, only the last parameter could be estimated.

One of the radiographic measures that can assess the quality of root canal treatment is the length of the root filling [34,35,5]. According to that criterion 41.3% of root filled teeth in this study are inadequately filled root canals.

Despite, the fact that a root filling increases the risk of AP, this study demonstrates that the quality of the root filling is important in relation to the presence of AP. This is also shown in other studies [36,10,37,38,5,39,33,40,41].

There are numerous clarifications for slow or lack of bone formation after inadequate length/extension of root fillings, but this is mainly associated with infection in the apical part of the root canal. Over extension of the root filling may encourage a foreign body reaction at the periapical region that may not be related to the existence or absence of infectious agents or other irritants in the root canal. Over instrumentation often precede overfilling, which may push pulp remnants and microorganisms beyond the apex.

There was no statistical association between AP and smoking or diabetes mellitus; this could be due to small sample size (8 smokers and 6 diabetic patients). The evaluation of socioeconomic status was not included in this study. The dental care at dental schools is far less expensive in Sudan when compared to dental care at private clinics. Moreover, all the patients in the study are of middle socioeconomic status and most of them (98.5%) visit the dentist irregularly. Besides that, many previous studies reported that, the socioeconomic level has no effect on the periapical status of the individuals [11,42,43,9].

5. Conclusion

The following conclusions were drawn: The main risk indicators of having AP in the individual were the high plaque percentage, root fillings, the existence of numerous caries lesions and the quality of the dental treatment. The probability of AP was extremely significant after root canal treatment and was closely associated with the quality of the root canal filling.

Abbreviations

AP: Apical periodontitis

RF: Root-Filled

Compliance with ethical standards

Acknowledgments

To all patients who participated in this study.

Disclosure of conflict of interest

All the authors declare no conflict of interest.

Statement of ethical approval

The research protocol was approved by the ethical committee of the dental faculty; University of Khartoum.

Statement of informed consent

Written Informed consent was obtained from all individual participants included in the study.

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