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Prevalence of apical periodontitis and factors associated with the periradicular status

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Abstract

Aim. The present study aimed at assessing the prevalence of apical periodontitis and identifying the factors associated with apical periodontitis, particularly the influence of the quality of root canal fillings and coronal restorations on the periradicular status. ***Methodology.*** The study population consisted of adult patients, men and women, seeking routine dental care at the Endodontic Clinic in the school teaching hospital between September 2006 and July 2008. For each patient complete oral examination and periapical radiographs were made for pathological teeth. All teeth were assessed individually. AP was diagnosed according to defined criteria, other variables were root fillings, coronal fillings, trauma and caries. The odds ratio and 95% confidence interval were used to calculate the risk of apical periodontitis related to tooth-specific risk indicators on the presence of apical periodontitis. A multiple logistic regression model to control for confounders and to determine their independent association with apical periodontitis was used also. ***Results.*** AP was detected on teeth (63.79%). The prevalence of apical periodontitis in root canal-treated teeth was 39.5%. Of the dental variables caries, trauma, inadequate root fillings and inadequate restoration were significantly associated with AP. ***Conclusion.*** The prevalence of AP in this study group was higher than in other populations. The probability of AP increased significantly after root canal treatment and coronal filling and was closely associated with the quality of the filling.

Key Words: *apical periodontitis, quality of root canal fillings, risk of apical periodontitis*

Introduction

Apical periodontitis (AP) is an inflammatory process in the periapical tissues that may develop if bacteria are introduced into the dental pulp. It has been established beyond doubt that apical periodontitis is caused by bacteria within root canals [1,2]. Logically, the treatment of apical periodontitis should be removal of the cause, i.e. bacterial eradication. Mechanical debridement combined with antibacterial irrigation (2.5% sodium hypochlorite) can render 40–60% of the treated teeth bacteria-negative [3,4].

However, with regard to published studies, apical periodontitis seems more prevalent among root canal filled teeth than non-root canal filled teeth; and overall quality of root fillings is generally poor [5–12].

Many factors influence the outcome of endodontic treatment. Presence of bacteria and quality of endodontic therapy are the most cited in the literature [1,2,6–12]. Several cross-sectional studies have focused on prevalence and frequencies of AP and demonstrated that 30–50% of individuals exhibit AP. The presence and radiographic quality of a root filling and to some extent the radiographic quality of the coronal restoration were associated with AP in teeth [13].

The present study was undertaken to assess the prevalence of apical periodontitis from an urban adult Moroccan population and identifying the factors associated with apical periodontitis, particularly the influence of the quality of root canal fillings and coronal restorations on the periradicular status of these teeth.

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Materials and methods

The study population consisted of adult patients, men and women, seeking routine dental care at the Endodontic Clinic in the school teaching hospital at Rabat, Morocco between September 2006 and July 2008. The samples consisted also from patients referred by general dental practitioners.

This study design was retrospective and patients' records were used as a data source.

Inclusion criteria:

- No medical history,
- Tooth required endodontic treatment or re-treatment, and
- Only radiographs of high quality were included. Radiographs were considered of high quality when technique or processing were adequate.

Exclusion criteria:

- Teeth requiring apexification were excluded from analysis, and
- Teeth with resection.

The following pre-operative information was recorded before treatment: demographic data, tooth location, previous endodontic treatment, clinical signs and symptoms, response to percussion, vitality tests and periapical status. Based on these findings, the pre-operative condition was classified as one of the following:

- vital (irreversibly inflamed pulpitis),
- non-vital teeth without periapical lesion,
- apical periodontitis: more than double widening of the periodontal ligament space on the lateral aspect of a tooth or the presence of a radiolucent area connected with the apical part of the root in the periapical region,
- endodontically treated, with or without periapical lesion, and symptomatic or asymptomatic, or
- teeth were classified as either asymptomatic if there are no symptoms or clinical signs or diseased in the presence of tenderness to percussion or other clinical signs.

Criteria for evaluation of previous endodontic treatment were those used by the European Society of Endodontology [13]. Cases were considered as failures and required endodontic treatment in the presence of pain, swelling and sinus tract. Radiographically, failures were identified when a lesion appeared subsequent to endodontic treatment, when a pre-existing lesion increased in size and when a lesion had remained the same or had only diminished in size.

Endodontically treated teeth were examined for quality of root canal treatment. The quality of the root fillings were assessed by measuring the distance of the root filling from the radiographic apex of the tooth and the density.

Root filling density was assessed by noting the homogeneity of fill and whether voids were present.

Length of root filling and density was judged using the following criteria:

- adequate: root canal filling 0–2 mm short of the radiographic apex and
- inadequate: root canal filling >2 mm short of the radiographic apex, root canal filling extruded beyond the radiographic apex, root canal filling limited to the pulp chamber (amputation).

Density of root filling:

- adequate: radiodensity of fill was uniform and appeared to be radiographically adapted root canal walls and
- inadequate: canal space was visible or if the radiodensity was not uniform.

Coronal restoration was judged using the following criteria:

- Adequate: sealed filling and
- Inadequate: when open margins of filling was detected.

Statistical analysis

After data collection, statistical analysis was performed. It included univariate description to characterize the study material, analysis of associations between variables and to identify potential outcome predictors and multivariate analysis (logistic regression models) to identify significant factors associated with apical periodontitis.

In the analysis, teeth with AP were compared with teeth without AP. All tests were performed as two-tailed. The statistical analyses were carried out using the SPSS 13 for windows (SPSS Inc., Chicago, IL).

Results

Five radiographs that were inadequate for interpretation as a result of poor radiographic technique or processing were excluded. The remaining 301 teeth, whose radiographs were readable, constituted the basic material for evaluation in this study.

Table I shows the characteristics of the study population. Females seems to seek endodontic treatment more often than males, but this difference is not statistically significant ($p = 0.46$).

In our sample, molars were the most frequently treated teeth, followed by pre-molars. Canines were the teeth with the lowest frequency. Maxillary teeth are more frequently treated than mandibulary teeth.

Table I. Clinical characteristics of the study population.

Variables	
Age	30 ± 10.9
Gender	
M	172 (42.9%)
F	129 (57.1%)
Tooth type	
I	75 (24.9%)
C	13 (4.3%)
PM	82 (27.2%)
M	131 (43.5%)
Tooth location	
Maxilla	193 (64.11%)
Mandible	108 (35.89%)
Previous endodontic treatment	224 (74.41%)
Caries	56 (18.6%)
Trauma	21 (7%)
Coronal filling	
Yes	61.5%
no	38.5%
Apical periodontitis	
Yes	192 (63.79%)
no	109 (36.21%)

Values represent means ± SD or *n* (%).

The prevalence of AP in this study population was 63.79%.

Of the teeth examined, 74.41% have had previous endodontique treatment. The prevalence of apical periodontitis in root canal-treated teeth was 39.5%. AP was detected, respectively, in 95.6% and 87.9% of inadequate sealed teeth and when the length of root filling <2 mm.

In univariate analysis, inadequate endodontic treatment (OR = 29.37; 95% CI: 7.08–121.76, $p = 0.001$), inadequate restoration (OR = 7.61; 95% CI: 4.08–14.28, $p < 0.001$), incisive and molar tooth type, caries and trauma were significantly associated with AP in root-filled teeth. However, age and gender was not associated with AP.

In multivariate analysis, among the variables collected, inadequate endodontic treatment (OR = 14.93; 95% CI: 2.51–50.33, $p < 0.001$), inadequate restoration (OR = 3.26; 95% CI: 1.12–3.14, $p = 0.001$), caries (OR = 2.24; 95% CI: 1.08–3.22, $p < 0.001$) and trauma (OR = 2.61; 95% CI: 1.01–23.48, $p = 0.03$) were significantly associated with AP in root-filled teeth. However, age and gender were not associated with AP. In the multivariate analysis, inadequate endodontic treatment, presence of restoration, caries and trauma remained significantly associated with AP (Table II).

Discussion

The main concern of this paper was to assess the prevalence of apical periodontitis and to identify factors associated with AP.

It was found that apical periodontitis is relatively frequent in this sample (63.79%). This finding is more important than the results of some similar studies [14–19]. However, such findings from related studies should be compared with caution because of the variations in sampling procedures, varieties of participants, the type of radiograph examined, the criteria for diagnosing dental disease and so forth. In some studies patients were randomly selected within defined age groups, place of settlement (rural/urban population) or social groups [14,15], whilst others have used patients from within large dental clinics and within a defined time periods of examination [17,18].

In this study, data on the prevalence of AP in an adult population within Rabat were obtained as a result of analyzing clinical and periapical radiographs which were made for patients attending the Dental clinic in the Dental School of the Rabat Souissi University. This clinic deals with the treatment of residents of Rabat (the capital city of Morocco) and provides general and specialized dental care as well as patients from other areas who are routinely sent to the clinic for diagnosis and treatment of their dental problems. This school is one of the two dental schools in Morocco. Moreover, our sample included a great number of patients with previous endodontic treatment (74.41%), which may influence the prevalence of AP. Previous studies and the present stated that the apical periodontitis was strongly associated with root fillings, particularly technically inadequate root fillings. It was found that the presence of technically inadequate root fillings highly increased the risk of AP in the tooth [OR(after adjustment = 14.93; 95% CI: 2.51–50.33, $p < 0.001$], this association has been demonstrated in a number of previous studies [6–8,11,12]. Root fillings that end short of the apical constriction (>2 mm) and with poor density filling have been shown to have a poorer prognosis than those that end within 2 mm of the radiographic apex and with good density [14,20–23].

The present study found that the coronal restoration was related to the periapical health. The risk of having AP increased significantly if the tooth had an inadequate coronal restoration (OR = 7.61 in univariate analysis, OR = 3.26 in multivariate analysis). The effect of coronal leakage related to AP has been debated in several reports. It has been assumed that the quality of the seal created by the coronal restorations is one of the factors significantly associated with failure of endodontic treatment [10,24,25]. Coronal restoration, as well as the root-filling, serve as a barrier against fluid and bacterial penetration into the

Table II. Univariate and multivariate analysis for risk indicators of apical periodontitis.

	Univariate analysis			Multi-variate analysis		
	OR	IC 95%	*p*	OR adjusted*	IC 95%	*p* adjusted*
Inadequate endodontic treatment	29.37	7.08–121.76	0.001	14.93	2.51–50.33	<0.001
Coronal filling	7.61	4.08–14.28	<0.001	3.26	1.12–3.14	0.001
Tooth type						
I	4.32	2.04–9.18	<0.001	2.08	0.84–5.15	0.11
C	1.00					
PM	0.63	0.36–1.10	0.63	0.56	0.28–1.12	0.71
M	4.06	1.09–4.90	<0.001	3.86	0.15–3.16	0.10
Trauma	12.6	1.67–95.12	0.01	2.61	1.01–23.48	0.03
Caries	6.3	3.4–11.8	<0.001	2.24	1.08–3.22	<0.001
Age	1.02	0.99–1.04	1.02			ns
Gender	1.23	0.76–1.98	0.39			ns

*Adjustment for caries, trauma, tooth type, coronal filling and previous endodontic treatment.
OR: Odds ratio; IC: Confidence interval.

periapical area. Moreover, Ray and Trope [26] found that the technical quality of the coronal restoration was even more important for periapical health than the quality of root canal treatment. Other studies found that if the root filling was adequate then the coronal restoration was of less importance [25]. It seems reasonable, however, to emphasize that it is of importance to perform coronal restorations of high quality.

In the present study, periapical radiographs were used for the diagnosis of apical periodontitis. Some investigators have suggested that the use of panoramic radiography in epidemiologic studies of dental health was acceptable and the validity of evaluating the AP on panoramic radiography is reliable [26,27]. However, others found that periapical radiographs are superior to panoramic radiographs in the detection of periapical lesions [6,21,28] because panoramic radiography may under-estimate lesions occurred when used [29,30]. To minimize radiographic errors, only radiographs of high quality were included.

The present study showed also that individuals with carious lesions, coronal fillings and previous trauma had an increased risk of developing AP. This agrees with findings from some cross-sectional studies [9,31].

In the present study, it was found that molars and incisors presented a higher risk for AP. Some studies have found that molars more often are associated with AP [17,32–34], whereas others have found that front teeth were more affected than molars [14,35] and others again have found no difference [36].

The results of the present study showed that AP was not more likely to be detected in males than females ($p > 0.05$). Even if women had received more endodontic treatment than men, gender had no more effect on developing AP. This result agreed with previous studies [37–40].

The limitation of the present study is the sample used for analysis. Thus, the data obtained cannot be extrapolated to the entire population of the country. However, given the large sample size, it is possible to estimate the real prevalence of AP in the general population in Morocco. On the other hand, it's important to know that the clinic where the studies were conducted is one of the two specialized public centers providing endodontic care.

Recommendations

The results of this study and others show that, in spite of recent advances in endodontics, the goal of treatment is not always achieved. Discouraging results with regard to treatment quality from a technical point of view are observed. Endodontically-treated teeth should then be monitored by periapical radiographic examination.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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