

Epidemiological evaluation of apical periodontitis prevalence in an urban Brazilian population

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Declaration of Interests: The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

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DOI: 10.1590/1807-3107BOR-2015.vol29.0051

Submitted: Sep 02, 2014
Accepted for publication: Jan 08, 2015
Last revision: Feb 11, 2015

Abstract: The present study aimed to assess the prevalence of apical periodontitis (AP) in an urban Brazilian population according to gender, age group and tooth type. Data were collected from clinical files containing the medical and dental histories and periapical radiographs of 1,126 patients treated at the School of Dentistry at *Universidade do Estado do Rio de Janeiro* between March 2000 and December 2010. A total of 15,724 periapical radiographs were evaluated. All the radiographs were evaluated by two independent, previously calibrated endodontists ($\kappa = 0.88$). Periapical areas on the radiographs were classified as N (normal) or AR (apical radiolucency). The frequency of AP and the 95% Confidence Interval (95%CI) were calculated according to gender, age group and tooth type. Differences between groups were calculated using the Z-test at a significance level of 5% ($p < 0.05$). AP was present in 7.87% of the samples, with 16.70% occurring on previously endodontically treated teeth and 44.65% occurring on teeth referred for endodontic treatment (TR-RCT). The frequency of AP was higher among females (64%) than among males (35%). The central and lateral maxillary incisors were the most frequently affected teeth. The frequency of AP was higher among individuals between 30 and 49 years of age. In this population, AP was more prevalent among females and among individuals between 30 and 49 years of age, and the central and lateral maxillary incisors were the most frequently affected teeth.

Keywords: Periapical Periodontitis; Periodontitis; Radiography.

Introduction

Apical periodontitis (AP) is a complex multifactorial condition originating from an infected necrotic pulp or a failed endodontic treatment. AP often develops asymptotically, and the prognosis is typically less favorable when it is detected late. Epidemiological studies on the prevalence of AP in different countries have revealed that AP is a widespread oral health problem that may jeopardize systemic health.¹ AP affects a significant proportion of people in different populations, and several authors have reported frequencies in Kosovo (46.3%), Turkey (67.9%), Belgium (40%), Denmark (52%), Lithuania (39%), Canada (44% and 51%), Germany (61%), Scotland (51%), Spain (64.5%), and the United States (39%).^{2,3,4}

Results from cross-sectional studies have often associated AP with inadequate root-fillings,⁵ and the quality of the root filling has been

extensively documented as the most important determinant of endodontic success.^{5,6,7,8,9,10,11,12,13,14} Certain authors have indicated that age, gender, social class, education, occupation and use of dental services are among the risk indicators that may be associated with the presence of apical periodontitis.¹⁰ Other descriptive epidemiological studies have suggested that the presence of an apical lesion is dependent on tooth type.¹¹ The present study aimed to assess the prevalence of apical periodontitis in an urban Brazilian population according to gender, age group and tooth type.

Methodology

Sample selection

Data were collected from 1,126 clinical files containing medical and dental histories, dental exams and periapical radiographs of patients treated by undergraduate students at the Endodontics Clinic at the School of Dentistry at *Universidade do Estado do Rio de Janeiro* – UERJ between March 2000 and December 2010. The mean patient age was 37.1 ± 16.4 years, and the cohort contained 738 females (65.55%) and 388 males (34.45%). The study was approved by the Ethics Committee of the *Hospital Universitário Pedro Ernesto* (CEP-HUPE 2032-2008).

Radiographic examination

Radiographic evaluation was used to assess the number of endodontically treated teeth, endodontically treated teeth with apical radiolucency, teeth referred for endodontic treatment and teeth referred for endodontic treatment with apical radiolucency. A total of 15,724 periapical radiographs were evaluated. All teeth referred for endodontic treatment were treated at the Endodontics Clinic at the School of Dentistry at UERJ. The operator radiographs of these teeth were taken using an Odontomax 70/7P X-ray unit (Odontomax, Astex, São Paulo, Brazil) with the paralleling technique and Kodak Intraoral E-speed film (Eastman Kodak, Rochester, USA). All the radiographs were evaluated by two independent, previously calibrated endodontists ($\kappa = 0.88$). Radiographs with cuts, distortion, poor fit of the apical region, veiling or significant radiographic density alteration and images suggestive of endo-

periodontal disease or root-end surgery were excluded ($n = 664$). The periapical status of each tooth was assessed using the Periapical Index (PAI)¹⁵ as follows:

- N (normal): the periodontal ligament space and the surrounding bone show no alteration (PAI scores 1 and 2);
- AR (apical radiolucency): the presence of apical radiolucency or widening of the periapical ligament space to greater than twice the normal width (PAI scores 3, 4 and 5).

The same environmental conditions were maintained at all times during the radiograph analysis. A film-observer distance of 20 cm was maintained throughout the analysis. The room was darkened, and a black mask was used around the radiograph to limit light emission from the illuminating viewing box.

Statistical analysis

The frequency of apical radiolucency and the 95% Confidence Interval (95%CI) were calculated according to gender, age group and tooth type. The Z-test for proportions was used to determine statistically significant differences between proportions. The significance level was set at 5% ($p < 0.05$). The prevalence of apical radiolucency was assigned as a dependent variable, and age group, gender and tooth type were included as independent variables. The Statistical Package for the Social Sciences (SPSS 8.0 for Windows, Tokyo, Japan) was used for data management.

Results

Through the radiographic analyses of 1,126 patients (total number of teeth = 25,292), it was determined that 1,754 teeth had already received root canal treatment (RCT), of which 293 presented with apical radiolucency. In total, 3,807 teeth were candidates for referral for RCT, of which 1,700 presented with apical radiolucency. The prevalence of diabetes among the individuals in this sample was 18.48%, and the prevalence of high blood pressure was 33.57%. Three individuals had received a kidney transplant (0.27%), and one individual had undergone a coronary heart valve replacement (0.09%). The questionnaire used to assess the socioeconomic status of the population revealed that 70.33% of the individuals had only an elementary education degree and that 93.61% had a

monthly income of 1 minimum wage. Table 1 shows the distribution of patients by age group.

Apical radiolucency was present in 1993/25292 (7.87%) of the examined radiographs. Among previously endodontically treated teeth (PT-RCT), 293/1754 (16.70%) showed apical radiolucency, and 1700/3807 (44.65%) of the teeth referred for endodontic treatment (TR-RCT) showed apical radiolucency. The distribution and prevalence of apical radiolucency by age group is shown in Table 2.

The frequency of apical radiolucency was higher among females (62.41% in TR-RCT; 66.21% in PT-RCT) than among males (37.59% in TR-RCT; 33.79% in PT-RCT), although women were overrepresented in this sample (Table 3).

The central and lateral maxillary incisors were the most frequently affected teeth (10.87% and 7.70%, respectively), followed by the mandibular second premolars and first molars (3.60% and 3.44%, respectively), among those teeth referred for endodontic

treatment. The central and lateral maxillary incisors were the most frequently affected teeth (13.13% and 17.76%, respectively), followed by the mandibular first molar and the second and first maxillary premolars (21.77%, 13.77% and 12.57, respectively), among the previously endodontically treated teeth (Table 4).

Discussion

This cross-sectional observational study aimed to describe the prevalence of periapical lesions in an urban Brazilian population using periapical radiographs and dental and medical histories. Although most studies are based on radiographic evaluation, certain authors have used other variables, such as clinical notes and interviews.⁹ Previously, periapical radiography was the only imaging method available to diagnose post-treatment apical periodontitis.¹⁶ Periapical radiographs were chosen to assess periapical radiolucency because they have a higher sensitivity in detecting periapical osteolytic lesions than panoramic radiographs, especially in the anterior region.¹⁷ Muhammed *et al.*¹⁸ found no statistically significant difference between panoramic radiographs and full-mouth surveys in detecting periapical lesions.

The population described in the present study represents a convenience sample from the School of Dentistry at UERJ and is not representative of the entire Brazilian population. Therefore, comparisons with other populations should be performed cautiously. Differences in health care system, age, and methodology are likely to contribute to discrepancies.^{19,20}

Table 1. Age distribution and percentage of the total sample (n = 1,126)

Age group	N	(%; ±95C.I.)
0-18	125	11.1 ± 1.83
19-29	215	19.09 ± 2.3*
30-39	213	18.92 ± 2.29*
40-49	265	23.53 ± 2.48*
50-59	178	1.60 ± 0.73
60+	115	10.21 ± 1.77
Total	1,126	100.0

*Statistically significant (p < 0.05)

Table 2. Frequency and distribution of apical radiolucency among teeth with previous endodontic treatment (PT-RCT) and among teeth referred for endodontic treatment (TR-RCT) by age group (n = 1,993)

Age group	Frequency in PT-RCT	(%; ±95C.I.)	Frequency in TR-RCT	(%; ±95C.I.)
0-18	21	7.16 ± 2.95	267	15.71 ± 1.73
19-29	41	13.99 ± 3.97	283	16.65 ± 1.77
30-39	79	26.97 ± 5.08	370	21.76 ± 1.96
40-49	71	24.23 ± 4.91	373	21.94 ± 1.97
50-59	49	16.72 ± 4.27	193	11.35 ± 1.51
60+	32	10.92 ± 3.57	160	9.41 ± 1.39
Missing	0	0	54	3.18 ± 0.83
Total	293	100.00	1,700	100.00

Table 3. Distribution of teeth with apical radiolucency among teeth with previous endodontic treatment (PT-RCT) and among teeth referred for endodontic treatment (TR-RCT) by gender (n = 1,993)

Gender	Frequency in PT-RCT	(%±95 C.I.)	Frequency in TR-RCT	(%±95 C.I.)
Female	194	66.21 ± 5.42	1,061	62.41 ± 2.3
Male	99	37.79 ± 5.55	639	37.59 ± 2.3
Total	293	100.0	1,700	100.0

Table 4. Prevalence of apical radiolucency (AP) according the tooth type among teeth with previous RCT (TP-RCT) and among teeth referred for RCT (TR-RCT) (percentage and 95%CI).

Tooth type	TP- RCT	AP	(% of Total; 95%C.I.)	TR-RCT	AP	(% of Total; 95%C.I.)
Maxilla						
Central incisors	259	37	13.13 ± 4.11	811	414	10.87 ± 0.99*
Lateral incisors	214	41	17.76 ± 5.12	541	293	7.70 ± 0.85*
Canines	146	21	12.32 ± 5.33	299	124	3.26 ± 0.56
First premolars	183	26	12.57 ± 4.8	330	126	3.31 ± 0.57
Second premolars	167	26	13.77 ± 5.23	367	121	3.18 ± 0.56
First molars	139	15	8.63 ± 4.67	88	27	0.71 ± 0.27
Second molars	50	7	6 ± 6.58	21	2	0.05 ± 0.07
Third molars	5	0	0 ± 0	0	0	0.0
Subtotal	1,163	173	4.38 ± 4.18	2,457	1,107	29.08±1.44**
Mandible						
Central incisors	22	14	63.59±20.89	95	70	1.84±0.43
Lateral incisors	26	8	19.23±15.15	81	52	1.37±0.37
Canines	47	9	12.76±9.54	119	55	1.44±0.38
First premolars	112	20	15.17±6.64	195	85	2.23±0.47
Second premolars	117	16	11.11±5.69	342	137	3.60±0.59
First molars	147	34	21.77±6.67	324	131	3.44±0.58
Second molars	107	19	14.95±6.76	149	54	1.42±0.38
Third molars	13	0	0±0	14	3	0.08±0.09
Subtotal	591	120	16.92±3.02	1,319	587	15.42±1.15**
Missing values	0	0	0	18	6	0.16±0.13
Unclassified teeth	0	0	0	13	0	0.0
Total	1,754	293	14.31±1.64	3,807	1,700	44.65±1.58

*Not statistically significant (p > 0.05).

**Statistically significant (p < 0.05).

The number of individuals aged 40-49 years was significantly higher than that for the other age groups, with the exception of the 30-39 age group, suggesting that individuals of this age more frequently seek dental service. The mean age of the population described in the present study (37.1 ± 16.4 years) is similar to that described by Eriksen *et al.*⁷ but is lower than those reported by Tsuneishi *et al.*¹³ (50.8 years of age) and Georgopoulou *et al.*²⁰ (48.0 years of age).

Certain authors have shown an increase in both the prevalence of root-filled teeth and the presence of apical periodontitis with increasing patient age.^{7,13,19,20,21} The results presented herein revealed that the prevalence of apical periodontitis among teeth with previous endodontic treatment or teeth referred for endodontic treatment was highest in the 40-49 age group, followed by the 30-39 age group. Both the 50-59 and the 60+ age groups contained fewer patients with AP. Other studies

have reported the same skewed age distribution.^{4,22} One possible explanation is that younger individuals seek dental treatment at dental schools more often than older individuals due to the lower treatment cost at dental schools. Additionally, one cannot eliminate the possibility that older persons may undergo more tooth extractions rather than root canal treatments. Nevertheless, there was no statistically significant difference in the prevalence of AP between the age groups ($p = 0.068$).

The sample in our study contained more females (63.98%) than males (36.02%). Previous surveys that have reported similar results explained this gender discrepancy as occurring because women have a greater interest in receiving dental care.^{19,20} The present study showed a significant difference in AP between men (37.59%) and women (62.41%) ($p < 0.05$), which may be explained by the smaller number of males in this sample.

Most studies have shown that molars and premolars are the most common root-filled teeth^{13,20} with associated AP.^{8,11,21} The present results indicated that the central and lateral maxillary incisors were the most frequently affected teeth, followed by the premolars and the mandibular first molars. This difference could be explained by the socioeconomic status of our sample population; this population probably chose tooth extraction rather than root canal treatment followed by costly prosthetic treatment. In addition, central and lateral maxillary incisors are the teeth most frequently affected by trauma, which is often associated with AP lesions.

Indeed, socioeconomic variables have been frequently associated with AP. In our sample, 70.33% of the patients had only an elementary education degree, and 93.61% had a monthly income of 1 minimum wage. These variables provide a broad overview of the social class, living conditions and general health of the patients, although these variables may only indirectly affect disease occurrence. Other studies have indicated that regular dental care and caries experiences are strong disease determinants.²¹

Our study sample consisted of teeth that had been endodontically treated or had been referred for endodontic treatment. In the present study, 16.7% of the cases that had previous endodontic treatment also presented with apical periodontitis. This prevalence was similar to those previously reported.^{13,23} In cases

that were referred for endodontic treatment, 44.65% of the patients presented with apical periodontitis; this prevalence is similar to that reported in other countries (16%-65%).^{4,6,21,22,24,25} Certain studies have described a higher prevalence of apical periodontitis (60%-67.5%).^{19,20} According to Khabbaz *et al.*,²⁶ poorer dental health and inappropriate techniques may contribute to this higher prevalence.

Kirkevang and Wenzel¹⁰ have classified risk indicators for apical periodontitis, and they concluded that the most important risk indicator for apical periodontitis was radiographic evidence of root fillings. This finding is supported by several epidemiological studies.^{4,6,7,11,19,20,22,24,26,27,28,29,30,31} Ng *et al.*³² demonstrated the need to improve the technical quality of root fillings performed by undergraduate students, especially in molars. The technical quality of the root canal treatment and coronal restoration has a significant impact on the periapical health of root-filled teeth.

Apical periodontitis (AP) is a common sequela of pulp infection,³³ and the local inflammatory process aims to confine and limit the spread of infectious elements.³⁴ However, in AP, pulpal and periapical infection can potentially spread throughout the body, this being the most serious endodontic pathological condition from a general health view.³⁵ The association between inflammation of endodontic origin and systemic health has not been adequately reported in the scientific literature.^{36,37,38} The available scientific evidence is limited, but it is consistent in suggesting that AP may contribute to a systemic immune response that is not confined to the localized lesion, potentially leading to increased systemic inflammation.³⁹ Chronic apical periodontitis has been independently associated with coronary heart disease (CHD),³⁸ and surgical endodontic treatment has been demonstrated to reduce systemic inflammation.⁴⁰ These studies highlight the relevance of AP and the need for more studies on the epidemiology, etiology and risk factors of this important oral condition.

Conclusion

In this sample population, the frequency of AP was higher among individuals in the 30-49 age group; females were more often affected than males, and the central and lateral maxillary incisors were the most frequently affected teeth.

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