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ORIGINAL ARTICLE

Prevalence of apical periodontitis and root-filled teeth in 2500 panoramic radiographs of a Brazilian population sample

Prevalência de periodontite apical e dentes obturados em 2500 radiografias panorâmicas de uma amostra da população brasileira

Rebecca Dias Almeida[1], Ana Paula Negreiros Nunes Alves [2], Geibson Gois Brito[1], Guilherme Costa Soares [4], Paulo Goberlânio de Barros Silva[3], Thâmara Manoela Marinho Bezerra[4], Lúcio Mitsuo Kurita[5], Fábio Wildson Gurgel Costa[5]

1. Division of Clinical Dentistry, School of Dentistry, Federal University of Ceará, Fortaleza, Brazil. 2. Division of Oral Pathology, School of Dentistry, Federal University of Ceará, Fortaleza, Brazil. 3. Division of Oral Pathology, School of Dentistry, Unichristus University Center, Fortaleza, Brazil. 4. Division of Clinical Dentistry, School of Dentistry, Federal University of Ceará, Fortaleza, Brazil. 5. Division of Oral Radiology, School of Dentistry, Federal University of Ceará, Fortaleza, Brazil.

Abstract

Objective: This study aimed to evaluate the prevalence of teeth with apical periodontitis (AP), root-filled teeth with (RFTAP), and without apical periodontitis (RFT) in 2500 digital panoramic radiographs from an adult Northeastern Brazilian population sample. **Methods**: A retrospective study was conducted on 2500 panoramic radiographs from a private dental imaging center. Data regarding sex, age, RFT, AP, and RFTAP were collected. A descriptive statistical analysis was performed adopting p<0.05 as significant. **Results**: The female sex was more significantly associated with RFT and RFTAP than the male sex (p=0,023; p=0.040). The maxilla showed a higher association with RFTAP in the anterior region (p=0.023) and RFT in the posterior region (p=0.023). AP showed a higher prevalence in individuals aged ≥ 31 years (p<0.001). RFTAP showed higher prevalence in the age group 30-70 years (p<0.001). RFT exhibited a significant prevalence in individuals aged ≥21 years (p<0.001). **Conclusion**: This study showed a higher prevalence of RFT and a low prevalence of AP and RFTAP. Female patients presented a significantly higher prevalence of RFT and RFTAP. Age was an important factor associated with the prevalence of RFT, AP, and RFTAP.

Keywords: Epidemiological Studies; Panoramic Radiography; Endodontics..

Resumo

Objetivo: Este estudo teve como objetivo avaliar a prevalência de dentes com periodontite apical (PA), dentes obturados com (DOPA) e sem periodontite apical (DO) em 2.500 radiografias panorâmicas digitais de uma amostra da população adulta do Nordeste brasileiro. **Métodos:** Um estudo retrospectivo foi realizado em 2.500 radiografias panorâmicas de um centro privado de imagem odontológica. Dados sobre sexo, idade, DO, PA e DOPA foram coletados. Foi realizada análise estatística descritiva, adotando-se p<0,05 como significante. **Resultados:** O sexo feminino associou-se mais significativamente com DO e DOPA do que o sexo masculino (p = 0,023; p = 0,040). A maxila apresentou maior associação com DOPA na região anterior (p = 0,023) e DO na região posterior (p = 0,023). A PA apresentou maior prevalência em indivíduos com idade ≥ 31 anos (p <0,001). O DOPA apresentou maior prevalência na faixa etária de 30 a 70 anos (p <0,001). DO exibiu uma prevalência significativa em indivíduos com idade ≥21 anos (p <0,001). **Conclusão**: Este estudo mostrou maior prevalência de DO e baixa prevalência de PA e DOPA. Pacientes do sexo feminino apresentaram prevalência significativamente maior de DO e DOPA. A idade foi um fator importante associado à prevalência de DO, PA e DOPA.

Palavras-chave: Estudos Epidemiológicos; Radiografia Panorâmica; Endodontia

INTRODUCTION

Periapical lesions are the most frequently diagnosed pathologies of odontogenic origin. Caries, dental trauma, restorative procedures, and other etiological factors may violate the integrity of the tissues that protect the pulp, allowing infections in the dentin-pulp complex to occur[1,2,3].The tissue response against the infection may lead to external root resorption, resulting in radiographically visible radiolucent areas[4].

In this context, the endodontic treatment targets the disinfection of the root canal system to prevent the infection from spreading to the periapical tissues[5]. After the endodontic treatment, the periapical lesion should not persist, resulting in bone regeneration and, consequently, the gradual remission of the radiolucent area in the apical region of the tooth[4]. Endodontic treatment performed under aseptic conditions, following clinical protocols, usually achieves a high success rate (90-95%), as demonstrated by several clinical studies[6-11].

Important epidemiological findings obtained from cross-sectional studies conducted in different countries in Latin America and Europe have revealed a high prevalence of apical lesions in endodontically treated teeth[10,12,13,14]. Apical lesions

Correspondence: Fábio Wildson Gurgel Costa. 1823 Sargento Hermínio Sampaio Ave, Apartment 1206 Sul, São Gerardo; CEP 60320-105, Fortaleza-CE, Brazil. E-mail: fwildson@yahoo.com.br

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are highly prevalent in the general population and are often asymptomatic[3,15,16]. Radiographic examination is extremely important in the evaluation of the apical region and surrounding tissues, and, combined with a thorough clinical assessment, this imaging exam aids in the establishment of a more precise and reliable diagnosis[17,18]. Panoramic radiography is a widely used examination technique that enables the visualization of general anatomic and topographic features of the maxillomandibular complex, being employed in the diagnosis and planning of different dental treatments[15,16].

Investigating the prevalence of apical periodontitis is essential to evaluate the outcomes of endodontic treatment within a population. Studies have reported a high prevalence of apical periodontitis in several countries, revealing that up to 2/3 of the cases were associated with endodontic treatment, especially in teeth with incomplete root canal fillings ≥2 mm distant from the root apex[2].

Apical periodontitis is the main indication for endodontic treatment and the most common evidence of an inadequate or failed endodontic treatment. Therefore, the diagnosis of this pathological condition is extremely important to establish an effective treatment plan involving either endodontic treatment, retreatment, surgery, or even a combination of these procedures[2].

Considering the importance of epidemiological imaging studies in the field of endodontics and the necessity of data from different geographic regions to contribute to a worldwide perspective of this pathological condition, this study aimed to evaluate the prevalence of teeth with apical periodontitis (AP), root-filled teeth with (RFTAP), and without apical periodontitis (RFT) in 2500 digital panoramic radiographs from an adult Northeastern Brazilian population sample.

MATERIALS AND METHODS

Study design and sample

This retrospective cross-sectional study was carried out with 2940 digital panoramic radiographs recorded between December 2011 to December 2014 from a private imaging reference center located in Fortaleza (State of Ceará, Brazil). All teeth displayed in the panoramic radiographs were evaluated, except third molars. Exclusion criteria were imaging exams with poor visualization quality and duplicated radiographs. After the exclusion of 440 images, the final sample evaluated in this investigation amounted to 2500 digital panoramic radiographs. Data on sex, age, and presence or absence of RFT, AP, and RFTAP were collected. All images were obtained from the Cranex D teleradiography (Soredex, Orion Co, Espoo, Finland) system.

Image analysis

The number of RFT, AP, and RFTAP was obtained, and these variables were analyzed according to anatomical location (maxilla/mandible) and side (right / left). According to De Moor et al. 2000, RFT was characterized as teeth with a radiopaque material in the pulp chamber and/or root canals system; AP was characterized as the widening of the apical region of the periodontal ligament not exceeding two times the width of the lateral periodontal ligament space or the presence of a radiolucent area contiguous with the apical region of the root exceeding at least two times the width of the lateral periodontal ligament space; RFTAP were characterized as teeth with a radiopaque material in the root canals associated with AP.

The sample size calculation was designed to estimate the RFT, AP, and RFTAP prevalence with 95% confidence, with an estimation error not exceeding 2% (precision), and considering a 50% estimated prevalence of these variables (presumed prevalence). For this purpose, the following equation was applied: $n=z^2.P(1-P)/\varepsilon^2$ in which ZCG equals the value of the Z score (1.96) for the adopted confidence level (95%), P corresponds to the presumed prevalence (0,05) and ε is the tolerable error (0.02). Thus, a minimum sample size of 2,401 panoramic radiographs was estimated as necessary. An additional 4% was added to the sample due to the possibility of sample loss.

All imaging evaluations were completed after approximately 60 days. Forty radiographic assessments were performed daily (equally distributed between morning and afternoon shifts). The interval between shifts was at least 2 hours.

Calibration of the examiners

Before the radiographic analysis, two examiners were calibrated using 100 panoramic radiographs as references to establish uniform criteria for the imaging evaluation. An intra-examiner kappa value of 0.828 was achieved.

Statistical analysis

The collected data were tabulated in the Microsoft Excel 2010 software for Windows and the statistical analysis was performed using the Statistical Package for Social Sciences 17.0 software (IBM, California, Los Angeles). Fisher's Exact test and Chi-square test were used for inferential statistics. In all cases, the probability α of type I error (level of significance) was established as 0.05 (5%), and a p-value lower than 0.05 was considered statistically significant.

Ethical considerations

This study was approved by the Research Ethics Committee of the Federal University of Ceará, Brazil (#285/11). The anonymity of the subjects during the data processing was guaranteed, with no direct patient contact. Patient consent regarding the use of their panoramic radiographs for research purposes was obtained through a signed bona fide consent (Termo de Fiel Depositário,

in Portuguese) provided at the dental radiology center.

RESULTS

Based on the frequency of endodontic treatment associated with the apical lesion, which was 18.5 % in the endodontically treated group versus 2% in the group without endodontic treatment, sample power of 100% was estimated to reject the null hypothesis with a confidence value higher than 95%.

In the total sample, 58.6% of the participants were female and 41.4%, male. The age ranged from 3 to 92 years, with a mean age of 38 years (± 20), and most patients were aged 11 to 60 years (Table 1).

Table 1. Characterization of the sample according to sex, age and anatomical location of RFT, AP and RFTAP.

Variables	N	%
Sex		
Female	1466	58.6
Male	1034	41.4
Age (years)		
≤10	150	6.0
11-20	415	16.6
21-30	470	18.8
31-40	366	14.6
41-50	330	13.2
51-60	391	15.6
61-70	229	9.2
71-80	115	4.6
>80	34	1.4
RFT		
No	1337	53.5
Yes	1163	46.5
Anterior maxilla		
No	1967	78.7
Yes	533	21.3
Posterior maxilla		
No	1749	70.0
Yes	751	30.0
Anterior mandible		
No	2365	94.6
Yes	135	5.4
Posterior mandible		
No	1790	71.6
Yes	710	28.4
AP		
No	2257	90.3
Yes	243	9.7
Anterior maxilla		
No	2465	98.6
Yes	35	1.4
Posterior maxilla		
No	2468	98.7
Yes	32	1.3
Mandíbula anterior		
No	2480	99,2
Yes	20	0.8
Posterior mandible		
No	2318	92.7
Yes	182	7.3
RFTAP		
No	2321	92.8
Yes	179	7.2
Anterior maxilla		
No	2471	98.8
Yes	29	1.2
Posterior maxilla		
No	2485	99.4
Yes	15	0.6
Anterior mandible		
No	2487	99.5
Yes	13	0.5
Posterior mandible		
No	2366	94.6
Yes	134	5.4

Data expressed as absolute and percentage frequencies. RFT= root-filled teeth; AP= apical periodontitis and RFTAP= root-filled teeth with apical periodontitis.

The prevalence of RFT was 46.5%, AP 9.7%, and RFTAP 7.2%. The posterior mandible exhibited the highest number of AP and RFTAP cases (7.3% and 5.4%, respectively), whereas the posterior maxilla presented a greater number of RFT (30,0%) (Table 1).

Females were more significantly associated with RFT (p=0,023) and RFTAP (p=0.040) than males. In the posterior maxilla, the presence of root-filled teeth was significantly more prevalent in the female sex (p=0.023). Similarly, in the anterior maxilla, the number of root-filled teeth and apical periodontitis cases was more prevalent in females (p=0.023) (Table 2). RFTAP showed a significantly higher prevalence in the age group 30-70 years than in patients <30 or >70 years of age (p<0.001). Root-filled

teeth had a significantly higher prevalence in individuals aged ≥ 21 years (p<0.001). In the anterior (p<0.001) and posterior (p<0.001) maxilla, there was also an increase in the prevalence of root-filled teeth in the age groups >30 years. In the anterior mandible, a higher RFT prevalence was observed in subjects >51 years of age (p <0.001), and in the posterior mandible, >31-year-old individuals presented a higher RFT prevalence (p<0.001). AP prevalence increased from 41 years of age onwards in the anterior (p<0.001) and posterior (p=0.001) maxilla. In the anterior mandible, the AP prevalence increase was observed in patients aged 41-60 years (p=0.025), and 31-60 years (p<0.001) in the posterior mandible. In the anterior maxilla, RFTAP prevalence was higher in patients ≤41 years of age (p<0.001), whereas in the posterior region no statistically significant difference regarding age was detected (p=0.059). In the posterior mandible, a high RFTAP prevalence was observed in the age range 41-50 years, and 31-70 years in the anterior region (p<0.001) (Table 3).

Table 2. Characterization of the sample according to sex and presence or absence of RFT, AP and RFTAP and anatomical location.

Variables	Sex		
	Female	Male	p-value
RFT			
No	756	581	0.023
Yes	710	453	
Anterior maxilla			
No	1135	832	0.067
Yes	331	202	
Posterior maxilla			
No	1000	749*	0.023
Yes	466*	285	
Anterior mandible			
No	1377	988	0.077
Yes	89	46	
Posterior mandible			
No	1039	751	0.337
Yes	427	283	
AP			
No	1316	941	0.304
Yes	150	93	
Anterior maxilla			
No	1441	1024	0.122
Yes	25	10	
Posterior maxilla			
No	1444	1024	0.242
Yes	22	10	
Mandíbula anterior			
No	1454	1026	0.901
Yes	12	8	
Posterior mandible			
No	1358	960	0.842
Yes	108	74	
RFTLA			
No	1348	973*	0.040
Yes	118*	61	

Variables	Sex		
	Female	Male	p-value
Anterior maxilla			
No	1443	1028*	0.023
Yes	23*	6	
Posterior maxilla			
No	1456	1029	0.527
Yes	10	5	
Anterior mandible			
No	1457	1030	0.576
Yes	9	4	
Posterior mandible			
No	1383	983	0.471
Yes	83	51	

*p<0,05, Chi-square test. Data expressed as absolute fequency. RFT= root-filled teeth; AP= apical periodontitis and RFTAP= root-filled teeth with apical periodontitis.

Table 3. Characterization of the sample according to age and presence or absence of RFT, AP and RFTAP and anatomical location.

Age (years)										
	≤10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80	p-value
RFT										
No	144*	385*	355	173	96	90	52	30	12	<0.001
Yes	6	30	115*	193*	234*	301*	177*	85*	22*	
Anterior maxilla										
No	147*	408*	442*	298	219	237	127	69	20	<0.001
Yes	3	7	28	68*	111*	154*	102*	46*	14*	
Posterior maxilla										
No	148*	402*	409*	258	166	184	99	63	20	<0.001
Yes	2	13	61	108*	164*	207*	130*	52*	14*	
Anterior mandible										
No	148*	413*	464*	358*	311*	354	195	96	26	<0.001
Yes	2	2	6	8	19	37*	34*	19*	8*	
Posterior mandible										
No	148*	397*	400*	254	205	204	103	60	19	<0.001
Yes	2	18	70	112*	125*	187*	126*	55*	15*	
AP										
No	149*	406*	447*	318	281	322	200	105	29	<0.001
Yes	1	9	23	48*	49*	69*	29*	10*	5*	
Anterior maxilla										
No	150*	415*	467*	362*	317	382	224	114*	34*	<0.001
Yes	0	0	3	4	13*	9*	5*	1	0	
Posterior maxilla										
No	150*	414*	468*	360*	323	378	226*	115*	34*	0.001
Yes	0	1	2	6	7*	13*	3	0	0	

Age (years)										
Mandíbula anterior										
No	150*	414*	468*	365*	324	386	228*	112*	33*	0.025
Yes	0	1	2	1	6*	5*	1	3	1	
Posterior mandible										
No	149*	409*	451*	325	296	342	207	109*	30*	<0.001
Yes	1	6	19	41*	34*	49*	22*	6	4	
RFTLA										
No	150*	410*	455*	328	294	340	204	108*	32*	<0.001
Yes	0	5	15	38*	36*	51*	25*	7	2	
Anterior maxilla										
No	150*	415*	469*	364*	321	381	223	114*	34*	<0.001
Yes	0	0	1	2	9*	10*	6*	1	0	
Posterior maxilla										
No	150	414	469	365	325	385	228	115	34	0.059
Yes	0	1	1	1	5	6	1	0	0	
Anterior mandible										
No	150*	414*	469*	365*	324	390*	229*	113	33	0.004
Yes	0	1	1	1	6*	1	0	2*	1*	
Posterior mandible										
No	150*	411*	458*	332	308	353	210	111*	33*	<0.001
Yes	0	4	12	34*	22*	38*	19*	4	1	

*p<0,05, qui-quadrado test. Expressed data as absolute frequency. RFT= Root-filled teeth teeth; AP= apical periodontitis and RFTAP = root-filled teeth with apical periodontitis.

DISCUSSION

Panoramic radiography is an important radiographic method of examination for epidemiological purposes, as it is an easily accessible and widely requested examination by dentists around the world. Several studies have shown the use of this type of radiography to determine the distribution and prevalence of RFT, AP, and RFTAP.[12,15,16,18-2]1 In this context, the importance of this study resides in the size of the analyzed sample as well as its population representativeness, which were both higher in comparison with several other epidemiological studies.[12,15,16,18-22]

The use of different types of dental radiographs has been considered an adequate method to evaluate the periapical status in epidemiological studies. In this study, the prevalence of apical lesions in a subpopulation from Northeastern Brazil was obtained with digital panoramic radiographs. Regarding this imaging method, some researchers concluded that the use of panoramic radiography in epidemiological studies of oral health is acceptable and that the difference in diagnostic power between periapical and panoramic radiographs for the detection of apical lesions was not statistically significant, which reinforces the possibility of using panoramic radiographs in these studies.[23,24] In addition, the fact that all teeth can be observed in a single radiographic exam, the relatively low exposure to ionizing radiation, the convenience of obtaining panoramic radiographs, and the speed at which they can be obtained should be considered relevant aspects compared to periapical radiographs[17,18,20,25].

Our study sample consisted mainly of radiographic examinations obtained from females (58.6%), as similarly observed in other epidemiological studies[3,15,16,18,20-22]. The fact that most previous studies consulted have shown a higher prevalence in the female sex may probably be associated with a greater concern of women to seek specialized services for the treatment of oral cavity disorders.

The age range observed in the present study contrasts with those presented in population samples from different investigations in which a younger age group (18-39 years) was more prevalent[14,17,19,26]. Regarding the mean age of this study (approximately 38 years), similar results were observed in equivalent investigations[19,27], with higher mean ages being also reported[3,16,22,25]. The age distribution of the present sample was considered homogeneous, which was also seen in a similar study[16].

The RFT prevalence in our sample was 46.5%, which was higher

than the values observed in some studies[12,15,17,20-22,26-28], albeit similar to others[18,19,26,29]. The differences between the different radiographic studies may be associated with the access of the population to the health services in each country, as well as variations in the age stratification, as patients with higher age tend to have more RFT. Regarding sex, a higher prevalence was observed in females, a finding consistently shown in other studies[3,12,15,18]. However, some investigations also reported no statistical difference between male and female individuals [16,22]. The analysis of anatomical location evidenced that, in the posterior maxilla, the presence of endodontic treatment was statistically significant for the female sex in the present study. The prevalence of endodontically treated teeth was significantly higher in individuals aged 21 years or older, contrasting with the results of Jimenez-Pinzon et al.[27], in which individuals 18 years of age or older were evaluated, with no statistical difference between RFT and age groups.

The present study demonstrated an AP prevalence of 9.7%. This value equals those of some previous investigations,[18,22,29], and surpasses those found in other studies[12,15,16,27]. The conclusions drawn from these studies should be regarded with caution because of the variations in sampling procedures, population, type of radiographic examination, and criteria for the diagnosis of dental diseases. Furthermore, no association between AP and sex was detected in the present investigation, corroborating the findings of several other authors[12,14,19,22,27,29]. However, some researches[15,16,25] have also shown a predominance of AP in male patients. In our investigation, teeth with apical periodontitis showed a significantly higher prevalence in individuals aged ≥31 years, which was similar to the study by Jimenez-Pinzon et al.[27], in which the groups older than 50 years exhibited a higher prevalence of AP. In addition, our study demonstrated a higher concentration of AP in the age group of 51 to 60 years, differing from the study by Al-Omari et al.,[19] in which the highest frequency was in the age group of 46 to 55 years (18.8%).

The prevalence of RFTAP observed in the present study was 7.2%, considerably lower than the relative frequency reported in previous research, which ranged from 24.5% to 61%.[25] The comparison to other countries further highlights the lower prevalence observed: Norway (52.2%)[12]; France (31.5%)[18]; Ireland (25%)[20]; Greece (60%)[22]; Belarus (45%)[25]; Spain (64.5%)[27]; United States (31.3%)[28]; and Japan (40%)[30]. This significant variation between countries reinforces not only the impact of different geographic locations on the prevalence of endodontic lesions but also the importance of the data added by this study. The female sex was statistically significant more associated with RFTAP, which has not been reported by other studies[12,19]. RFTAP were observed mainly in the age range between 30 and 70 years, which had also been described in the literature[16,20].

Root fillings are one of the few prognostic factors that can be reliably recorded and followed up. Nevertheless, it is important to highlight that the radiographic image does not provide any insight into the procedure carried out. Furthermore, panoramic radiographs are not considered a standard diagnostic method for periapical lesions due to distortions and poor detailing, despite their routine use in clinical practice. However, this radiographic examination may still aid in the conduct of dental professionals when a probable periapical lesion is detected. Therefore, it could be considered a limitation of this study. Furthermore, the sample size, absence of detailed clinical data (such as patient income and city of residence), and inclusion of a single dental imaging center may not reflect the general population. Thus, this research encourages future studies focusing on correlations between patient sociodemographic characteristics and radiographic findings such as AP and RFTAP.

In conclusion, this study evidenced a higher prevalence of RFT and a low prevalence of AP and RFTAP (46,5%, 9,7%, and 7,2%, respectively) in a significant sample of digital panoramic radiographs, which is an important additional contribution to the literature. Moreover, female patients presented a significantly higher prevalence of RFT and RFTAP. Age was also an important factor associated with the prevalence of RFT, AP, and RFTAP.

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