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ORIGINAL ARTICLE

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Prevalence evaluation of apical periodontitis and its relationship with endodontic and restorative treatment in a community in Southern Brazil

Avaliação da prevalência de periodontite apical e sua relação com o tratamento endodôntico e restaurador em uma comunidade no sul do Brasil

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ABSTRACT

Objective: The aim of this study was evaluate the prevalence of apical periodontitis (AP) in endodontically treated teeth (ETT) and relate it with demographic factors, quality of endodontic treatments and coronal restorations. **Material and methods:** Data were collected from patient's dental records wich contained full-mouth radiographic series. In ETT, arch, dental group and presence of AP were evaluated. Quality of root canal filling, presence and quality of coronal restoration and type of restorative material were also collected. Data were evaluated using descriptive statistics and Chi-square Test. **Results:** Of 70 patients included in the final sample, the majority were female (54.3%) and age ranged from 13 to 77 years (47.14 ± 13.18). Of 1,333 teeth evaluated, 73 (5.4%) had endodontic treatment, being the majority maxillary (74%) and anterior teeth (52.1%). Of teeth without endodontic treatment, 320 (25.4%) had AP. Failure rate was high (52.8%) and quality of root canal filling and coronal restoration were considered inadequate in the majority of cases (58.3% and 47.7%, respectively). Dental group had a statistically significant relationship with presence of AP in ETT, being more frequent in anterior teeth (p = 0.019). **Conclusion:** It was concluded that prevalence of AP in ETT was high and dental group was the factor that most influenced prevalence of AP in ETT.

KEYWORDS

Apical periodontitis; Radiography; Root canal filling.

RESUMO

Objetivo: O objetivo deste estudo foi avaliar a prevalência de periodontite apical (PA) em dentes tratados endodonticamente (DTE) e relacioná-la com fatores demográficos, qualidade dos tratamentos endodônticos e restaurações. **Material e método:** Foram coletados dados de prontuários odontológicos de pacientes que continham levantamentos radiográficos periapicais completos. Nos DTE, arco, grupo dental e presença de PA foram avaliados. Dados sobre a qualidade da obturação do canal radicular, a presença e a qualidade da restauração e o tipo de material restaurador também foram coletados. Os dados foram avaliados por estatística descritiva e Teste Qui-quadrado. **Resultados:** Dos 70 pacientes incluídos na amostra final, a maioria era do sexo feminino (54,3%) e a idade variou de 13 a 77 anos (47,14 ± 13,18). Dos 1333 dentes avaliados, 73 (5,4%) tinham tratamento endodôntico, sendo a maioria em dentes superiores (74%) e anteriores (52,1%). Dos dentes sem tratamento endodôntico, 320 (25,4%) apresentavam PA. A taxa de falha foi alta (52,8%) e a qualidade da obturação do canal radicular e da restauração foram consideradas inadequadas na maioria dos casos (58,3% e 47,7%, respectivamente). O grupo dentário apresentou relação estatisticamente significante com a presença de PA em DTE, sendo mais frequente nos dentes anteriores (p = 0,019). **Conclusão:** Concluiu-se que a prevalência de PA em DTE foi alta e o grupo dentário foi o fator que mais influenciou a prevalência de PA nos DTE.

PALAVRAS-CHAVE

Periodontite apical; Radiografia, Obturação do canal radicular.

INTRODUCTION

Currently, a large number of teeth are kept in the oral cavity by performing endodontic treatments, which restore oral health and function for patients, with a consequent social impact [1]. However, some epidemiological studies have reported the prevalence of apical periodontitis (AP) in these endodontically treated teeth (ETT) [2-11].

Apical periodontitis can be described as an inflammatory pathology, of acute or chronic nature, that affects the periapical region of teeth. Its triggering factor is the invasion and colonization of the root canals by bacteria that penetrate the periapical tissues, generating an immune response, which causes inflammatory response and damage to the supporting tissues [12,13]. When ETT have AP, it can be said that there was failure in endodontic treatment [10].

There are several reasons that may lead to endodontic treatment failure, however, causes that require clinical operator's control are constantly related to AP cases, including the presence of poorly obturated canals and inadequate coronary restoration [2,9,14,15]. According to the literature, the technical quality of root canal fillings and coronary restorations are contributing factors to the appearance of AP in the ETT, but the impact that each of these factors have on the occurence of the pathology is still controversial [3,5,10, 11,16-19].

In this way, the study of the prevalence of AP is important for the development of strategies to prevent this pathology, since it is an important risk factor for dental loss [20]. In addition, it is also important to establish if AP occurs as a result of inadequate endodontic or restorative treatments, thus requiring improvement of the quality of dental procedures; or as a result of lack of treatment, since endodontic procedures are considered costly and therefore inaccessible to a portion of the population [18].

There are reports of studies evaluating the prevalence of AP in patients from several countries, and their results show variability both in prevalence and causes for AP pathogenesis [4,6,14,16]. However, there are still few reports of studies on the subject performed in Brazil, and yet, these few reports refer to the results found in the Southeast and Northeast regions of the country [3, 10, 11].Based on the aforementioned reasons, the primary aim of this study was to radiographically evaluate the prevalence of apical periodontitis (AP) in endodontically treated teeth (ETT), to determine the radiographic success of treatment in patients who sought dental care at the Faculty of Dentistry of Federal University of Pelotas, located in South of Brazil. Additionally, we aim to evaluate prevalence of AP in teeth without endodontic treatment and relate the prevalence of AP with patient's demographic factors, such as gender and age, and its relation with quality of endodontic treatment and presence and quality of restorative treatment in those teeth.

MATERIAL AND METHODS

This cross-sectional retrospective study was submitted and approved by local Ethics Committee (number 2.407.543). The sample consisted of 70 patients who sought routine dental care at the Faculty of Dentistry, Federal University of Pelotas (FO UFPel) and performed a full-mouth radiographic series at the Radiology Clinic from 2011 to 2017.

The sample size is a convenience sample and is not representative of the entire Brazilian population. The sample was composed by the dental records and full-mouth periapical radiographs of patients treated at the clinics of FO UFPel and registered at the Central Service of Radiology, during the period between January of 2011 to December of 2017. Initially, dental records of 282 patients were included.

The following inclusion criteria were applied: patients with at least 9 periapical radiographs performed on the same date (this number of radiographs was determined considering the edentulism characteristics of the patients and the position of the teeth present in the dental arches); radiographs that presented

quality for interpretation, that is, examinations without distortion and with average density and contrast; radiographs of permanent teeth with closed apex; radiographs showing complete visualization of the root apex and its adjacent tissues. Third molars were excluded from the evaluation.

The radiographs previously selected were analyzed under ideal conditions of light, using a white light negatoscope and magnifying glasses with a magnification of 4x. Previously to the analysis of periapical radiographs, two evaluators received a theorical and practical calibration ministered by an Endodontist and a Dental Radiologist. The evaluators individually analysed the radiographs, and in case of disagreement, a third autor was consulted. This calibration, inter and intra-examiner, followed criteria established by the literature [10] and was tested using the Kappa statistic, in which a mean value of agreement was found to be satisfactory ($k = 0.78$).

Data were collected regarding the patients gender and age; number of present teeth, number of teeth with AP without endodontic treatment and number of ETT. In these ETT, besides the arch and dental group, the presence of AP, the quality of root canal filliing, the presence and type of restorative material, the presence and quality of the restoration were evaluated.

The presence of AP was assessed in all teeth, endodontically treated or not, according to the methodology used by Siqueira et al. (2005) [10]. For the ETT, in the absence of AP the treatment was considered as success, whereas in the presence of AP, it was considered as failure. Teeth presenting normal width of periodontal ligament space and no destruction of surroding bone were considered as cases of absence of AP.

Root canal filling was considered adequate if: all root canals of the tooth were obturated, with no empty spaces inside the root canals; root canal filling ending between 0 to 2 mm short of radiographic apex or if there was only endodontic cement extravasated out of the canal. On the other hand, obturation was considered inadequate if one of root canal was not filled; if empty spaces could be observed inside the root canal; if the canal was obturated more than 2mm below the radiographic apex or if there was gutta-percha beyond the apical foramen. In multiradicular teeth, if one of the canals was considered inadequate, the teeth was classified as inadequate obturation.

The coronal restoration, if present, was evaluated as adequate if it did not present excess of restorative material or marginal gap in the radiographic images; excess of lining material or adhesive material on the walls of the cavity; presence of saliences, open margins, recurrent caries, excess of adhesive material or lining material on the walls of the cavity, or if was made with provisional material. The restorative dental materials was also evaluated: silver amalgam, composite resin or prosthetic crown.

Data were analysed using descriptive statistics. Additionally, the success or failure of the endodontic treatments was determined, as well as the relationship between the presence of AP in the ETT with sociodemographic factors, as gender and age of patients; arch and dental group; quality of the obturation; presence, quality and type of coronal restoration, using Chi-square Test. The level of significance adopted for the statistical test was 5% and statistical analysis were performed using the software IBM SPSS Statistics 23® (IBM Corporation, Armonk, Nova York, EUA).

RESULTS

Of 70 patients evaluated, 32 were men (45.7%) and 38 women (54.3%). The age ranged from 13 to 77 years (mean of 47.14 ± 13.18 years); 9 patients (12.9%) were aged between 13 and 29 years; 32 (45.7%) between 30 and 49 years; and 29 (41.7%) were between 50 and 77 years of age.

In these patients, 1333 teeth were evaluated, and the average number of teeth per patient was 19 teeth, ranging from 7 to 28 (third molars were not evaluated). Endodontic treatment was present in 73 teeth (5.4%). Of

the 1260 remaining teeth, without endodontic treatment, 320 (25.4%) had AP.

Table 1 shows the results of ETT evaluation. Of the 73 teeth that had endodontic treatment, the great majority (74%) were upper teeth. Regarding the dental group, the distribution was uniform, with a slight predominance of incisors and canines (52.1%).

Table 1 also shows a higher failure rate of the ETT (52.8%), in comparison with the success rate (47,2%), since the number of ETT without AP was lower (34) than the number of ETT with AP (38). The quality of obturations and restorations was considered inadequate in most cases (58.3 and 47.7%, respectively), and eight teeth (12.3%) had endodontic treatment but no restoration. Among restored teeth, the majority (60%) presented silver amalgam restoration.

Table 1 - Absolute (n) and relative (%) values of ETT distribution, according to study variables

Variable (sample)		n (%)
Dental Arch (n=73)	Upper	54 (74)
	Lower	19 (26)
Dental Group (n=73)	Anterior	38 (52.1)
	Posterior	35 (47.9)
AP (n=72)*	Absent	34 (47.2)
	Present	38 (52.8)
Root canal filling (n=72)*	Adequate	30 (41.7)
	Inadequate	42 (58.3)
Restoration quality (n=65)*	Adequate	26 (40)
	Inadequate	31 (47.7)
	Absent	8 (12.3)
Type of Restoration (n=55)*◊	Amalgam	33 (60)
	Resin	10 (18.2)
	Prosthesis	12 (21.8)

* Missing data
◊ Teeth without restoration were not considered in the sample

The variables that presented missing data refer to radiographs in which it was not possible to completelly evaluate the periapical or coronary region, due to the incomplete image on radiograph.

Table 2 shows the relation of AP in ETT regarding sex and age of the patients; dental arch and dental group; quality of the obturation; presence, quality and type of restoration. The AP was more prevalent among women, in teeth with inadequate filling and absent coronary restoration. However, only the dental group had a statistically significant difference (p = 0.019), showing that AP was more frequent in incisors and canines compared to premolars and molars.

Table 2 - Relationship between presence of AP in ETT and demographic data of patients and teeth assessed

		AP in ETT		
Variable		Absent	Present	P
Sex* (n=71)	Male	16	14	.586
	Female	18	23	
Age Group*† (n=72)	13 to 29	2	2	.948
	30 to 49	10	12	
	50 to 59	22	24	
Dental Arch * (n=72)	Upper	28	25	.185
	Lower	6	13	
Dental Group * (n=72)	Anterior	12	25	.019**
	Posterior	22	13	
Root canal filling* (n=72)	Adequate	16	18	.523
	Inadequate	14	24	
Restoration quality*† (n=65)	Adequate	15	11	.712
	Inadequate	14	17	
	Absent	2	6	
Type of Restoration* (n=55)	Amalgam	16	17	.726
	Resin	7	3	
	Prosthesis	6	6	

* Missing data
** Statistically significant by chi-square test
† Applied Fisher's Exact Test

Table 3 presents the percentage of AP in each dental groups of anterior ETT. Central incisors were the dental group with highest prevalence of AP (47.27%), followed by lateral incisors (31.48%) and canines (21.04%). Overall, the upper arch presented a higher number of ETT affected by AP, in comparison to the lower arch. The central incisor 21 showed the highest prevalence of AP of all anterior teeth.

Table 3 - Percentage of AP in each dental groups of anterior ETT

	Central Incisors		Lateral Incisors		Canines		Total
	Teeth	n(%)	Teeth	n(%)	Teeth	n(%)	n(%)
Upper Arch	11	6(15.7)	12	6(15.7)	13	3(7.89)	
	21	8(21.05)	22	4(10.52)	23	3(7.89)	
Lower Arch	31	2(5.26)	32	1(2.63)	33	1(2.63)	2
	41	2(5.26)	42	1(2.63)	43	1(2.63)	24
Total		18(47.27)		12(31.48)		8(21.04)	38(100)

DISCUSSION

This observational study aimed to evaluate the prevalence of AP in ETT, determining the radiographic success or failure of endodontic treatments, and factors related with this pathology. One of the limitations of the study is the cross-sectional design, wich means the periapical radiographs were analyzed in a single moment, without information about the time between endodontic treatment and radiographic examination, and it is not possible to evaluate if the periapical changes observed in the ETT corresponded to a chronic periapical lesion or a repair process. However, Terças et al. (2005) [11], who also performed a cross-sectional study, stated that research with this methodology may promote useful information on the prevalence of AP in the population of interest. Also, one may reflect on the predominance of amalgam restorations, indicated treatments performed longer.

Another limitation of this study was the impossibility to colect data regarding patient's health or socioeconomic conditions due to missing information in most of patients dental records. Problems in the storage, management and handwriting of these paper-based dental records contribute to data exclusion. In a similar study wich also slected patients dental records, it was not possible to evaluate 49,5% of the initially selected records, due to lack of data or incomplete information [24].

Likewise, due to the cross-sectional design of this radiographic study, the determination of the quality of obturations and restoration was performed only by visualizing the radiographic images, without considering clinical and biological conditions of the treatments. However, according to the literature, periapical radiographs are an important tool in the diagnosis of apical pathologies, since they provide detail and image quality, especially when compared to panoramic radiographs [2,4,17,21].

When compared with cone beam CT, periapical radiographs have the advantage of generating less exposure to X-rays, besides being the first option of complementary examination [3]. However, periapical radiographs show a two-dimensional image of three-dimensional structures, so apical periodontitis may be underestimated when analyzed by radiographic examination compared to CBCT [3].

A total of 1333 teeth were evaluated, of which 73 (5.4%) were endodontically treated. However, of the 1260 remaining teeth, that is, without endodontic treatment, 320 (25.4%) had AP. Knowing that teeth with AP need endodontic treatment, it is important to point the reasons for this high rate of untreated teeth, which may be the result of a lack of meticulous evaluation by dental practitioners to identify initial periapical lesions, as well as lack of referral of these patients to endodontic treatment. Nevertheless, for most of population, access to endodontic treatment is still insufficient and oral health preventive programs are not available in public health services, explaining the present results [6,11].

The prevalence of AP in teeth without endodontic treatment was similar to that found in the study of Farah et al. [22], which found a prevalence of 22%; but was higher when compared to other studies which found AP prevalences of 5.9% [11] and 3.3 to 4.2% [16] in teeth with no endodontic treatment. Socioeconomic differences regarding the samples of these studies, besides prevention programs that these populations may have received can explain the prevalences variance.

Regarding the ETT (5.4%), the majority belonged to the upper arch and the anterior dental group (52.1%) with a statistical significance (p = 0.019). In view of the great financial cost of endodontic proceedures, these results could be explained by the behavior of the population evaluated, which often opts for the extraction of a tooth in need of endodontic treatment, especially if these teeth were posterior, as reported by Kirkevang et al. (2012) [16], giving priority to endodontic treatment of anterior teeth due to the aesthetic matter and social importance of these dental group. Terças et al. (2006) [11] also found a higher prevalence of AP in anterior teeth. Spatafore et al. (1990) [23] mentions that these results may be related to the fact that the upper lateral incisors have curvature in the apical third, making a successful treatment difficult to achieve. Another important factor is that many general dental practitioners perform endodontic treatment of anterior teeth, due to technical facility compared to posterior teeth, but ignore the fact that lower incisors and canines may present a second canal, which may not be instrumented, thus leading to failure of the endodontic treatment. Also, the high percentage of anterior ETT affected by AP is explained by the propensity of maxillary incisors of being affected by dental trauma, which is often associated with AP lesions (BERLINK, 2015).

AP was found in 52.8% of ETT. Similar results were found in other studies (32.8% [2]; 35.4% [3]; 39% [4]; 31% [5]; 46.3% [6]; 42.5% [11]; 49% [14]; 23.8% [17]; 45.7% [18]). The high prevalence of AP found in ETT is concerning, since the presence of this patology is related to an unfavorable prognosis, besides being one of the aspects that characterize the failure of the endodontic treatment. According to this finding, obturation was considered inadequate in 58.3% of the ETT, which corroborates results of other studies, with the prevalence of inadequate fillings of 65% [2], 77% [5], 69.5% [6] and 67% [14].

The high percentage of AP in ETT suggests that, overall, dentists are performing ineffective root canals disinfection, leading to unsuccessful endodontic treatments, as inadequate root fillings alow the maintence of bacterial by-products into the canals wich can double the risk of AP when compared to adequate endodontic therapy [4]. However, the radilucencies associated with root-filled teeth observed in radiographic images in a single a time, limits the evaluation of the periapical lesion activity, which may correspond to a chronic or a healing lesion, leading to an overestimation of teeth with AP. It's important to emphasize that the quality of root fillings is the most critical determinant of endodontic success [25]. When performed in controlled clinical enviroments, endodontic treatments provide an adequate prognosis and show success rates up to 96% [7,8,9].

Regarding the quality of restoration, it was observed that 47.7% of the restorations were inadequate and 8 teeth (12.3%) had no restoration, as in the study of Moreno et al. (2013) [14], where 60% of the teeth had inadequate restoration or absence of restoration, and only 47% of these had a healthy apical periodontium. Siqueira et al. (2005) [10] showed a prevalence of 46.7% of teeth with adequate coronary restorations, with success rate of endodontic treatment of 58.7%. Teeth with inadequate restorations represented 37.1%, with an endodontic success rate of 45% for this group. Teeth without restoration (16.2%) had endodontic success of 34.8%. From the data of the above mentioned study, it is possible to affirm that the endodontic success rate decreases in the presence of an inadequate restoration or in the absence of restoration.

In the present study, despite the higher rate of AP in teeth with inadequate fillings, it was not possible to verify a statistically significant relationship between these two factors (p = 0.523), a similar result was reported by Jersa et al. (2013) [5].

One of the causes of endodontic treatments insuccess is strongly linked to marginal failures of coronal restorations, since the frequency of apical periodontitis increases in teeth with inadequate quality of restorations, compared to teeth with adequate restorations [2, 18]. In addition, the quality of a restoration after the treatment conclusion is of extreme importance to obtain better perradadicular conditions, as reported in the study of Moreno et al. (2013) [14] and Ray & Trope (1995) [15], thus contributing to te absence of periapical pathologies, such as AP. In our study, it was also possible to find a higher prevalence of AP when the restorations were inadequate and especially when the teeth were not restored. However, it was not possible to associate the presence of AP in the ETT with presence and quality of restoration ($p = 0.712$).

Among the types of restorations observed in ETT, 60% were silver amalgam, similarly to the findings of Dawson et al. (2016) [2], with a 46.6% rate, representing the highest prevalence among the restorative materials observed by these authors. Yet, the restorative material could not be related to the presence of AP in ETT in the present study ($p = 0.726$). Likewise, for Dawson et al. (2016) [2], the restorative material exerts less influence on the periapical condition when compared to the quality of the restoration.

It was possible to notice that prevalence of AP was high in both ETT and teeth without endodontic treatment. The present findings are not restricted to this study population, since research conducted in other locations of Brazil, as well as in other countries, also reports high prevalences of AP. According to Moreno et al. (2013) [14], universities and dental authorities should be aware of this matter and suggest, as possible forms of resolutions, the revision of the curricular structure on graduation programmes, as well as the execution of researches aiming the development of low cost and effective treatments for population, and even, the restriction of endodontic care to specialists. It is evident from the results found, the need for new approaches that improve the information and access of the population to endodontic treatment, but especially the development of strategies to achieve endodontic success.

CONCLUSION

In view of the proposal of this study and the applied methodology, we can conclude that the prevalence of AP in ETT was high. Also, that the anterior teeth was the dental group with the highest prevalence of AP in ETT.

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