

Frequency and characteristics of endodontic findings in digital panoramic radiography

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Abstract

Background: Clinical epidemiological studies do not allow us to know the status of pulp and periapical disease of endodontic origin, information that can be obtained analyzing panoramic radiographs, so as to provide prevention and counseling services in oral health. Objective: To determine the frequency and characteristics of endodontic findings in digital panoramic radiographs. Methods: We analyzed 1,500 digital panoramic radiographs of patients over 18. The following information was recorded: number of teeth in the mouth,

number of teeth with endodontic treatment and condition, periapical radiolucent area, fracture, resorption, broken instruments, perforations, pulp stones and hypercementosis. Results: 48% of the radiographs showed at least one endodontic finding. 39.5% were endodontic treatments in a total of 1,594 teeth, of which 52.7% were underfilled, 44.9% were in good condition and 2.5% were overfilled. 69% of the filled teeth were in the upper jaw. 275 (18.3%) radiographs presented a periapical radiolucent area. 4.4% of the radiographs showed at least one tooth with resorption. No differences between men and women were detected for any of the findings. Endodontic treatment and the presence of a periapical radiolucent area increase significantly with age. Conclusion: Pulp and periapical disease has a high prevalence in the population studied and requires better prevention mechanisms. Inadequate filling of the canals is a variable to consider to avoid apical lesions, and to improve the prognosis of the tooth.

Keywords: Radiographs, endodontic treatment, endodontic treatment in good condition, underfilling and overfilling.

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Introduction

Diseases of the oral cavity are an important part of public health services given the high cost of dental care. From the epidemiological perspective in dentistry, the most relevant data is provided by tooth decay, periodontal disease, edentulism and malocclusions. However, the records of pulp diseases are not accurate because clinical diagnosis requires x-ray imaging to see the dental canal and periapix. Furthermore, digital panoramic radiography taken under the right conditions has become essential to fully assess the patient. Additionally, given its low cost, professionals can conduct other population studies complementary to oral health clinical studies.

Leyva et al.⁽¹⁾ studied 603 panoramic radiographs and found that 28% showed some kind of pathology, including osteoesclerosis, cysts, cementoblastomas, and others. Other studies that have looked at the need for endodontic treatment have found variable data. This information depends, to a large extent, on the tooth decay rates, which is the main cause of pulp damage and therefore of endodontic treatment. Boykin et al.⁽²⁾ studied 873 adults; 13% required at least one conventional endodontic treatment or apical surgery, or endodontic retreatment within 48 months. A systematic literature review made by Pak et al.⁽³⁾ showed that in highly developed countries, out of a total of 300,861 teeth, 10% had been endodontically treated and 5% had some type of apical lesion.

The 4th National Study on Oral Health (ENSAB)⁽⁴⁾ conducted in Colombia was a clinical study. As such, it does not provide more specific data on the needs for endodontic treatment in the Colombian population, bearing in mind that these are different from other countries because of tooth decay indexes, as mentioned above, access to health services, and the possible restoration options for the affected tooth. Therefore, the aim of this study was to determine the prevalence and characteristics of endodontic findings in digital panoramic radiographs.

Methods

With the endorsement of the Research and Ethics Committee of the School of Dentistry of Universidad Pontificia Javeriana, we conducted a descriptive study to analyze 1,500 digital panoramic radiographs of patients over 18 obtained from different radiology centers in the city of Bogotá. The variables analyzed in each radiograph were: number of teeth in mouth, number of restored teeth, type of restored tooth, condition of restoration (good, underfilled, overfilled), presence of periapical radiolucent area, vertical/horizontal fracture, internal/external resorption, fractured instruments, perforations, pulp stones and hypercementosis. To analyze the radiographs that showed some kind of endodontic treatment, we classified patients into four age groups: 18-30, 31-40, 41-50, and over 50. The data was analyzed through descriptive statistics using Excel pivot tables and shown in

tables and figures. Frequencies were analyzed using the Chi² test with a p<0.05 significance.

Results

To determine the frequency of endodontic findings, we analyzed the radiographs as a marker of what occurs in the adult population (Table 1) and on the teeth taken as independent units. (Table 3). For both cases, we report the distribution in the total sample, by sex and age.

The results showed that 48% of the population presented a finding related to dental pulp, with similar frequencies in men and women. Endodontic treatment was the most frequent finding (Table 1, Fig.1). The number range of root canals detected on radiographs was 1 to 18. Of the radiographs, 86.4% showed 1-5 root canals, 11.4% had 6-10, and 2.2% had 11-18 treatments. The presence of periapical radiolucent area followed by resorption (Figure 2) were the two other most frequent findings (Table 1).-

	Population	%	Men	%	Women	%
Total number of radiographs analyzed	1,500	100	638	100	862	100
Total number of radiographs with findings	721	48	313	49	408	47.3
Endodontic treatment	593	39.5	249	39	344	39.9
Periapical radiolucent area	275	18.3	129	20.2	146	16.9
Resorption	66	4.4	25	3.9	41	4.75
Others	12	0.08	5	0.08	7	0.08

Table 1. Distribution of absolute and relative frequencies of the endodontic treatments found in the radiographs analyzed



Fig. 1: Panoramic radiograph that shows endodontically treated teeth



Fig. 2: Partial take of a panoramic radiograph that shows teeth with resorption

The other findings analyzed (Figure 3) had a very low frequency. No statistically significant differences between men and women were detected for any of the findings.



Fig. 3: Partial take of a panoramic radiograph that shows a horizontal fracture.

As mentioned in the Methods section, radiographs were classified according to patient age into five groups (Table 2). The results confirmed in terms of an increase in endodontic pathology with age, especially for endodontic treatment and the presence of a periapical radiolucent area, with a significantly lower frequency in the 18-30 group, compared with the 31-40 group ($p=0.00000$) ($p=0.00000$), a significant increase of almost twice as much in the 31-40 group, and high frequencies over the age of 41 ($p=0.0000$) ($p=0.003$). No significant differences were found between men and women within each age group for any of the findings studied.

Age (years)	18-30		31-40		41-50		51-60		> 61	
	M	F	M	F	M	F	M	F	M	F
Total number of radiographs analyzed	287	411	155	183	88	138	54	75	54	55
Endodontic treatment	44	71	65	80	63	95	41	57	36	41
Periapical radiolucent area	30	39	32	32	29	38	19	22	19	15
Resorption	8	22	7	9	5	2	3	4	2	4
Others	3	1	2	3	0	1	0	1	0	1

Table 2. Absolute frequencies of findings related to dental pulp in panoramic radiographs, distributed by age and sex

A total of 39,940 teeth were analyzed, of which 5.4% presented some type of endodontic finding. Something similar was found in radiographs regarding the frequency of such findings, and there was a similar distribution in men and women, without statistically significant differences (Table 3).

	Population	%	Men	%	Women	%
Total number of teeth in mouth	39,940	100	16,921	100	23,019	100
Average number of teeth in mouth	27	1.	26	1.	27	1.
Total number of teeth with endodontic finding	2,143	5.4	901	5.32	1,242	5.39
Endodontic treatment	1,590	4	660	3.9	930	4
Periapical radiolucent area	389	0.97	189	1.1	202	0.88
Resorption	159	0.4	51	0.3	108	0.47
Others	13	0.03	5	0.03	8	0.03

Table 3: Absolute and relative frequencies of endodontic findings in the radiographs studied

A total of 1,590 endodontically treated teeth were classified according to their condition: 44.9% showed endodontic treatment in good condition, whereas about half were underfilled (52.7%), and 2.5% were overfilled. There was some type of restoration in 95.6% of the endodontically treated teeth.

When we analyzed the frequency of endodontic treatment by tooth type, we found a higher frequency in the upper jaw (69.1%); the upper and lower first molars, and the upper central incisors had the highest treatment frequency (Figures 3 and 4).

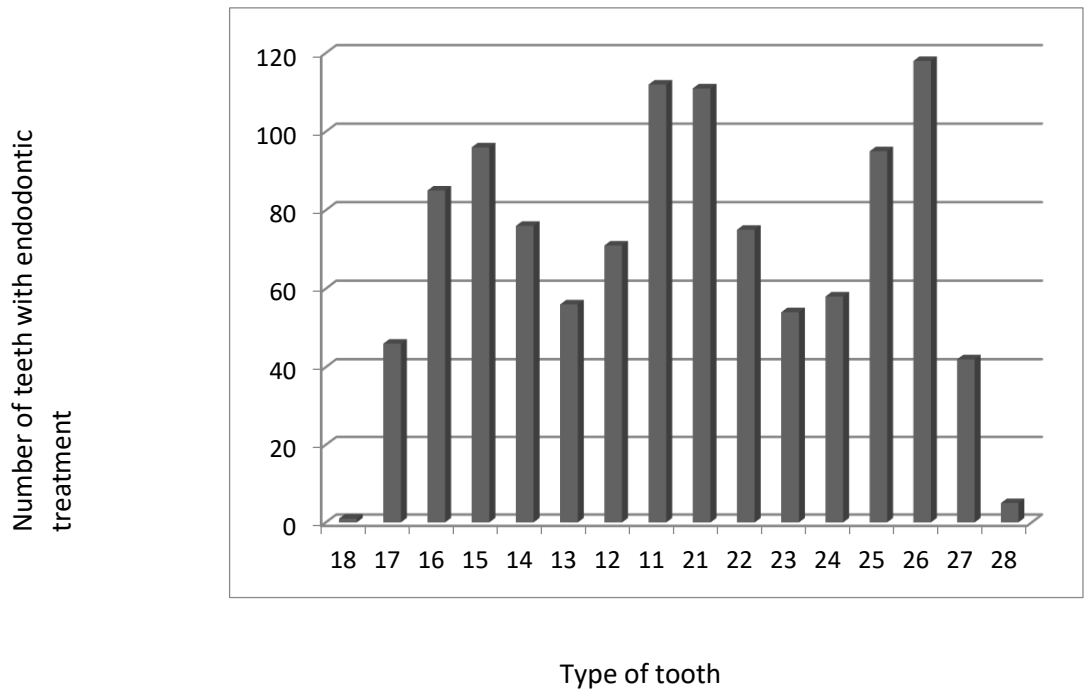


Chart 1: Number of endodontically treated teeth according to type on the upper jaw

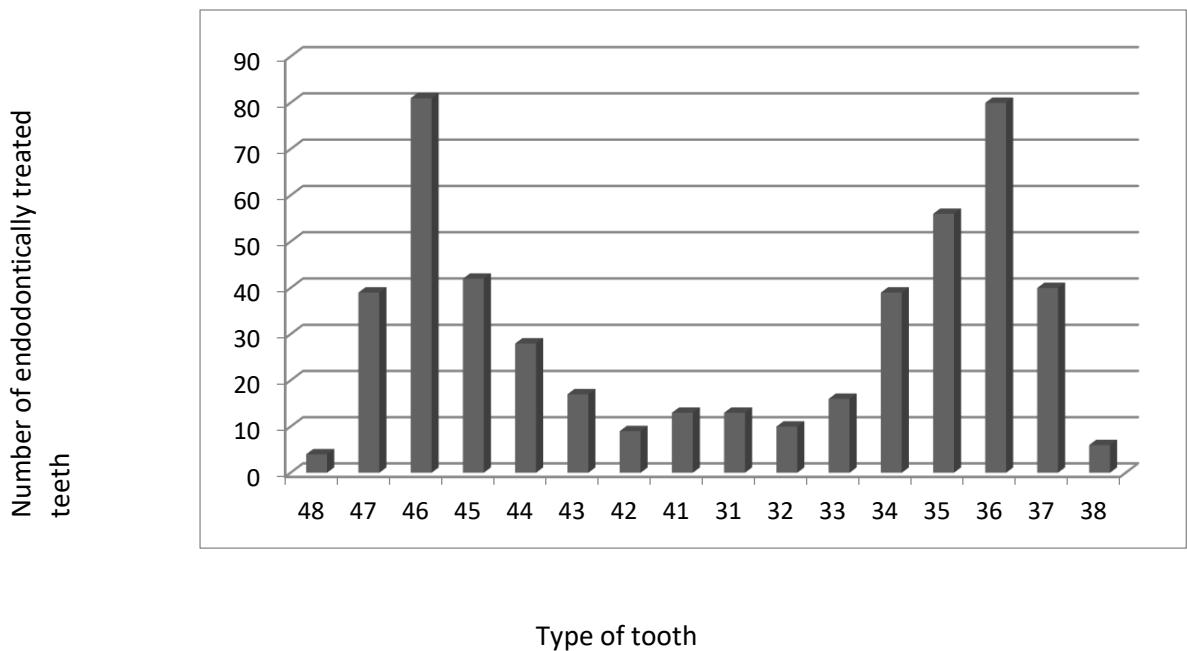


Chart 2: Number of endodontically treated teeth according to type on the lower jaw

The analysis of the presence of a periapical radiolucent area showed that of the total number of teeth in the mouth, 0.6% of those with no endodontic treatment had apical lesions, whereas 11% of teeth with endodontic treatment had an apical lesion ($p < 0.000000$). However, the OR calculation ($OR = 0.047$) showed a negative risk ratio between having a root canal and having an apical lesion. Of the 389 teeth with periapical radiolucency, 171 (44%) had endodontic treatment, of which 66% were underfilled, 31% were well filled, and 3% were overfilled.

Regarding the age distribution of endodontic findings, when we analyzed the information by age group and sex, we found a pattern that was similar to that in radiographs, with a progressive rise in findings as the age of the individuals increased; no significant differences were observed between men and women.

Age (years)	18-30		31-40		41-50		51-60		> 61	
Sex	M	F	M	F	M	F	M	F	M	F
Total number of teeth in mouth	8,309	12,181	4,416	5,176	2,108	3,329	1,165	1,548	923	785
Average number of teeth in mouth	30	29	28	28	24	24	21	21	17	15
Total number of teeth with endodontic finding	133	218	196	231	255	357	159	275	158	161
Endodontic treatment	67	104	136	167	208	296	127	237	122	126
Periapical radiolucent area	44	47	45	39	37	54	27	31	32	25
Resorption	18	66	14	21	10	6	5	6	4	9
Others	4	1	1	4	0	1	0	1	0	1

Table 4: Absolute frequencies of the findings related to the dental pulp in the teeth seen in panoramic radiographs, by sex and age groups

Discussion

Endodontic treatment followed by a quality rehabilitation allow patients to keep teeth functional, and the assessment of endodontic findings shows the access to and quality of health services that help preserve teeth. These findings provide data regarding pulp diseases measured through root canal imaging and other radiographic findings. The dental situation has improved since the last study into oral morbidity in Colombia, from an average of 21 to 27 teeth in mouth, due to changes in prevention and care models, or better oral care for aesthetic reasons.

It is clear, however, that the frequency of pulp disease or its prevention remains high, since nearly half the population examined radiographically (48.1%) has some type of pulp disease finding, 39.5% of which is a root canal treatment, with a higher frequency in women, although the prevalence by teeth is 5.4%. This could be linked to the cavities prevalence in young adults, which affects 47.79% of individuals aged 18, at age 35 it increases to 64.73%, and at 65 to 61.11%, to dentoalveolar trauma (17.2%) in adolescents, and to prosthetic requirements⁽⁴⁾.

Each population differs according to risk factors, access to health services, financial or cultural reasons. This can be seen in a sample of 1,473 Russian patients older than 15: the study concludes that 20% of the teeth studied had been endodontically treated⁽⁵⁾. Furthermore, in Finland, 27% of the population has at least one root canal⁽⁶⁾. The decrease in the need for endodontic treatments in all age groups, as in Sweden, illustrates the impact of oral health prevention programs on a population⁽⁷⁾. Finding more root canals means there is a better chance of preserving the tooth in the mouth, but also that there is a higher prevalence of pulp disease for any of the reasons already mentioned.

Radiographs with endodontic treatment findings range between 1 and 18 root canals; of the 376 (37.6%) radiographs with endodontic findings, 325 (86.4%) presented between 1 and 5 root canals, with an average of 3.5 root canals per patient, a value that is considered high, when in other populations this figure does not exceed two treatments per patient⁽³⁾. A systematic literature review showed that 10% of the teeth studied have a root canal⁽³⁾, whereas in this study, 4% of the teeth had been endodontically treated. These figures may be considered low in an environment where tooth decay has a high frequency and severity among adults, which might suggest that many teeth are removed instead of being treated and restored.

The first molars have the highest number of root canals as they have a higher risk of suffering tooth decay since they are in the mouth the longest; however, upper middle molars also have a high frequency of

treatment, possibly on account of tooth decay. Another issue that could also be studied is if dentoalveolar trauma during childhood and adolescence could have led to the treatment.

Of the total number of teeth studied, 0.97% in 18.3% of radiographs have an associated apical lesion, figure which tends to decrease with age, unlike other reports where it goes from a 50% prevalence at age 50 to a 62% prevalence at age 60 and over⁽⁸⁾, or in Brazil with a lesion prevalence of 7.87%⁽⁹⁾, which is explained here because patients prefer extraction to retreatment or apical surgery. The presence of apical lesions indicates an increased need for treatment, since it is necessary to redo the endodontic treatment or apical surgery, which may entail an unfavorable prognosis for the tooth treated and increase costs.

Apical periodontitis may be an indication of endodontic treatment failure. This is consistent with studies like that of Humomne et al.⁽⁶⁾, who establish a clear connection between the prevalence of apical periodontitis in endodontically treated teeth when compared to periodontitis in unrestored teeth. In abutment teeth for fixed partial dentures, something similar occurs: 46.5% of lesions are connected to endodontically treated teeth, whereas only 25% of teeth without endodontic treatment showed apical periodontitis⁽¹⁰⁾. Similarly, Kabac et al.⁽⁵⁾ show that 12% of the teeth have apical lesions, 45% of which in restored teeth. In the Finnish population, 39% is associated with teeth with apical periodontitis.

In a study of 4,617 teeth, De Moor et al.⁽¹¹⁾ found that 40.4% had an apical lesion. Most lesions can be classified through histopathological studies as granulomas⁽¹²⁾, which are considered a risk factor for tooth loss^(13,14). In addition, given their microbial etiology, they are now linked to diabetes⁽¹⁵⁾ and cardiovascular disease⁽¹⁶⁾.

An important finding in this study was that 52.7% of the teeth are considered underfilled, associated with 66% with apical lesions vs 44.9% in those within the normal range. This is consistent with De Moor et al.⁽¹¹⁾, who found that out of the 6.8% of the restored teeth, 56.6% restorations were considered unacceptable. A cone-beam tomography analysis showed that 23.04% of teeth are inadequately restored, and the risk of an apical lesion increases 4.38 times⁽¹⁷⁾. A study conducted by Moreno et al.⁽¹⁸⁾ showed that 51% of the teeth treated had no periradicular pathologies, and only 33% were considered properly restored.

Findings compatible with external resorption were observed in 27 radiographs, with high variance according to sex and age. External resorption has been connected to a number of factors. However, it occurs mainly because orthodontic treatment is an irreversible condition that adversely affects tooth prognosis⁽¹⁹⁾.

Dental fractures have a low frequency in this study, despite being considered by other authors as a public health problem given their high prevalence, especially in children and adolescents, although high-precision studies cannot be conducted with panoramic radiographs⁽²⁰⁾.

Endodontic treatment must aim for the best tooth prognosis in the long term, and this depends on the skill of the operator both for diagnosis and for treatment, the technology and materials used, as well as the possibility of restoration to preserve the tooth in optimal conditions.

Conclusions

These endodontic findings allow us to recognize the impact of pulp disease, be it derived from tooth decay, trauma or poor-prognosis treatments, as a risk factor for tooth loss in adult patients of all ages, with its aesthetic and functional consequences, as well as the need to implement strategies to promote oral health in the adult population.

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