

PREVALENCE OF APICAL PERIODONTITIS AND QUALITY OF ENDODONTIC TREATMENT IN AN ITALIAN ADULT POPULATION

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SUMMARY

Prevalence of apical periodontitis (AP) and quality of endodontic treatment in an Italian adult population

Objective. The aim of this study was to analyze the prevalence of AP in relation to the quality of endodontic treatment in an Italian adult population.

Methods. We examined panoramic radiographs (OPG) of 384 patients aged between 18 and 60 years who came under observation for a first dental examination. Two experienced examiners assessed the radiographs according to standardized criteria by examining the following parameters: periapical status, quality of endodontic treatment, quality of root canal filling and quality of coronal restoration.

Results. 9423 teeth were analyzed. By examining the radiographs 1076 teeth had undergone previous endodontic treatment, of these 448 (41.6%) had AP. Statistical analysis shows a significant association between periapical status and quality of endodontic treatment ($p < 0.001$), between periapical status and quality of root canal filling ($p < 0.001$) and between periapical status and quality of coronal restoration ($p < 0.001$).

Conclusions. The prevalence of AP was found to be closely related to the quality of endodontic treatment, quality of root canal filling and coronal restoration.

Key words: apical periodontitis, endodontic treatment, panoramic radiographs.

RIASSUNTO

Prevalenza della parodontite apicale (AP) e qualità del trattamento endodontico in una popolazione adulta italiana.

Obiettivo. Analizzare la prevalenza di PA in relazione alla qualità del trattamento endodontico in una popolazione adulta italiana.

Metodi. Sono state esaminate 384 ortopantomografie (OPT) di pazienti di età compresa tra i 18 ed i 60 anni giunti in osservazione per una prima visita odontoiatrica. Due esaminatori esperti hanno valutato le radiografie seguendo un criterio di valutazione standardizzato esaminando i seguenti parametri: stato periapicale, qualità del trattamento endodontico, qualità del riempimento canalare, qualità del restauro coronale.

Risultati. Sono stati analizzati 9423 elementi dentari, dei quali 1076 mostravano all'analisi radiografica un pregresso trattamento endodontico, di questi 448 (41.6%) presentavano PA. Dall'analisi statistica si evidenzia un'associazione significativa tra lo stato periapicale e la qualità del trattamento endodontico ($p < 0.001$), tra lo stato periapicale e la qualità del riempimento canalare ($p < 0.001$) e tra lo stato periapicale e la qualità del restauro coronale ($p < 0.001$).

Conclusioni. La prevalenza di PA è risultata essere strettamente correlata alla qualità del trattamento endodontico, alla qualità del riempimento canalare e del restauro coronale.

Parole chiave: parodontite apicale, trattamento endodontico, ortopantomografia.

Introduction

Apical periodontitis (AP) appears to be a pathological condition common in adults, as reported in several epidemiological studies conducted in Europe, North America and Australia, which show a prevalence of AP ranging from 27% to 70% (1). AP is often associated with endodontically treated teeth with a percentage between 18.2% and 61% (1-9). In fact, according to literature, a major cause of AP is the poor quality of endodontic treatment (1). Some studies have shown that the success rate of endodontic treatment is over 90% (7); many of these, however, were reported from specialists in endodontics or university clinics (3,7,10). In fact, if we analyze the studies in which endodontic treatments were performed by general practice, this percentage falls within a range that varies from 65% to 75% (3,7). Therefore, the quality of endodontic treatment appears to be crucial for maintaining the health of periradicular tissues. AP can be diagnosed with clinical investigations, noting the presence of pain and swelling, or through X-ray survey which represents the most useful diagnostic tool (11). In fact, only 5% of chronic periapical lesions, which represent the majority of AP, becomes symptomatic in a year (11). Numerous studies in literature have focused on the prevalence of AP and quality of endodontic treatment through the evaluation of panoramic radiographs (OPG) (5,7) or intraoral radiographs (3,4,6,8). The purpose of this study was to evaluate, using OPG, the prevalence of AP in relation to quality of endodontic treatment in an Italian adult population and to investigate factors that may influence these variables.

Materials and methods

We examined panoramic radiographs (OPG) of 384 patients who came to our dental clinic for a first dental examination. Two examiners, who are specialists in endodontics, evaluated radiographs of good quality in standard conditions, using the view box placed in a dark room with a magnification (x2). None of the examiners performed the treatment procedu-

res of patients in the study. For each patient a medical record was completed with age, sex, number of teeth present and number of endodontically treated teeth. The study excluded third molars, the elements that had received dental care over the past two years, the teeth which underwent root-end resection and rhizectomy and doubtful diagnostic cases. For each tooth endodontically treated the following parameters were evaluated: periapical status, quality of endodontic treatment, quality of root canal filling, and quality of coronal restoration. The radiographic criteria for the classification of **periapical status** and the radiographic evaluation of AP were as follows:

- no AP: no periapical radiolucency and normal width of periodontal ligament space;
- presence of AP: widening of the apical part of the periodontal ligament not exceeding two times the width of the lateral periodontal ligament space or radiolucency in connection with the apical part of the root, exceeding at least two times the width of the lateral part of the periodontal ligament.

Multirouted teeth were classified in relation to the root which showed the most severe periapical condition.

The criteria for radiographic assessment of the **quality of endodontic treatment** are based on guidelines published by the European Society of Endodontology (ESE) (11):

- adequate endodontic treatment (value 1): root canal filling 0-2 mm short of the radiographic apex;
- inadequate endodontic treatment (value 2): root canal filling >2 mm short of the radiographic apex (underfilled);
- inadequate endodontic treatment (value 3): root canal filling extruded beyond the radiographic apex (overfilled);
- inadequate endodontic treatment (value 4): root canal filling limited to the pulp chamber.

In addition, we evaluated the **quality of root canal filling** of each endodontically treated tooth:

- satisfactory (value 5): radiographic analysis of the filling is devoid of visible empty spaces;
- unsatisfactory (value 6): radiographic analysis of the filling shows visible voids;

Finally, we evaluated the **quality of coronal restoration** on each endodontically treated tooth in relation to the following parameters:

- adequate (value 7): radiographic analysis shows the presence of sealing due to coronal restoration;
- inadequate (value 8): radiographic analysis shows the absence of a seal due to coronal restoration.

Statistical analysis. For a descriptive analysis we used frequencies and percentages. To evaluate possible associations between the presence or absence of AP (main outcome) in relation to the quality of endodontic treatment-filling and restorative therapy, we used the chi-square test. The significance level was set at $p < 0.05$. The software used for statistical analysis was SPSS12.0 for Windows.

Results

In this study we examined 384 patients aged between 18 and 60 years (average 43.0), equally distributed in relation to age, and of these, 44.3% were males and 55.7% females. 9423 teeth were evaluated (average number of teeth per patient = 24.5), of which 1076 through radiographic analysis revealed previous endodontic treatment in a range between 0 and 7 teeth treated per patient (average number = 2.8). No difference in relation to the number of endodontically treated teeth was observed between males and females ($p = 0.523$).

Radiographic analysis of 1076 endodontically treated teeth demonstrated that, according to periapical status classification, 448 teeth (41.6%) had AP. The

statistical analysis shows a significant association ($p < 0.001$) between periapical status and quality of endodontic treatment (Table 1). In fact the value 1 (corresponding to a root canal filling 0-2 mm short of the radiographic apex) appears to be the one with the fewest cases of AP (28.4%) compared to the value 3 (overfilled) (30.6%), value 2 (underfilled) (51.8%) and the value 4 (root filling present only in pulp chamber) (56.5%). The evaluation of the periapical status in relation to the quality of root canal filling is also very significant ($p < 0.001$) (Table 2). As is evident in Table 2, endodontically treated teeth with a satisfactory root canal filling have a lower percentage of AP than those with inadequate filling (31.7% vs 48.4%).

The absence of a good quality of endodontic therapy (derived from the quality of endodontic treatment-filling) is related in a significant way ($p < 0.001$) to the presence of AP (Table 3).

Furthermore, the data observed show how important the quality of endodontics is in relation to the type of the element ($p = 0.020$) (Table 4). As can be seen in Table 4 the teeth that have an unsatisfactory quality of endodontics are the lower molars (82.41%) followed by the lower anterior (81.25%) and upper molars (74.65%). The quality of post-endodontic restoration presents a significant correlation respect to the periapical status ($p < 0.001$) (Tab. 5). In fact, an adequate coronal restoration was associated with a low percentage of AP (32.8%) while incongruous post-endodontic coronal restoration presents 52.7% of AP.

Table 1 - Periapical status assessment in relation to the quality of endodontic treatment.

Endodontic treatment	Periapical status		p
	No	AP (%)	
Value 1: 0-2 mm short of the radiographic apex	312 (71.6)	124 (28.4)	<0.001
Value 2: > 2mm short of the radiographic apex (underfilled)	192 (48.2)	206 (51.8)	
Value 3: root canal filling extruded beyond the radiographic apex (overfilling)	50 (69.4)	22 (30.6)	
Value 4: root canal filling limited to the pulp chamber	74 (43.5)	96 (56.5)	

Table 2 - Periapical status assessment in relation to the quality of root canal filling.

Filling	Periapical status		
	No PA (%)	PA (%)	p
Value 5: Satisfactory	298(68.3)	138(31.7)	<0.001
Value 6: Unsatisfactory	330(51.6)	310 (48.4)	

Table 3 - Periapical status assessment in relation to the association of quality of endodontic treatment and root canal filling.

Endodontic treatment+filling	Periapical status		
	No PA(%)	PA(%)	p
Satisfactory	206 (74.6)	70 (25.4)	<0.001
Unsatisfactory	422 (52.8)	378 (47.3)	

Table 4 - Evaluation of the association of quality of endodontic treatment and root canal filling in relation to the type of teeth examined.

Type of teeth	Endodontic treatment +filling		Total	p
	Satisfactory (%)	Unsatisfactory (%)		
ant sup	70 (30.43)	160 (69.57)	230	
ant inf	12 (18.75)	52 (81.25)	64	
prem sup	72 (27.91)	186 (72.09)	258	
prem inf	48 (28.92)	118 (71.08)	166	
mol sup	36 (25.35)	106 (74.65)	142	
mol inf	38 (17.59)	178 (82.41)	216	0.020
Total	276	800	1076	

Table 5 - Periapical status assessment in relation to the coronal restoration.

Coronal restoration	Periapical status		Total	p
	No PA (%)	PA (%)		
Value 7: adequate	402 (67.2)	196 (32.8)	598	
Value 8: inadequate	226 (47.3)	252 (52.7)	478	<0.001
Total	628	448	1076	

Discussion and conclusions

Numerous epidemiological studies conducted in several countries of Europe, North America and in the United States have assessed the prevalence of AP by observing X-ray examinations as the OPG, the intraoral full or combination of both diagnostic tests (3,7,12, 13,14). The OPG is a test widely used in epidemiological studies because it provides a faster execution and less exposure to radiation compared to a full intraoral (15). The accuracy of the OPG in the diagnosis of AP has been discussed by Ahlqwist et al. (15), who reported that the OPG, in the diagnosis of periapical pathology compared to full intraoral has a sensitivity of 76% and 90% for single and multirooted teeth respectively.

Moreover, modern orthopantomography generate radiographic images of better quality, even in the anterior region (7).

Muhammed & Manson-Hing (16) observed that, in the diagnosis of AP, there are no statistically signi-

ficant differences between full intraoral and OPG and, according to Grondahl (17), the interindividual variability between examiners is greater when using OPG rather than full intraoral.

In this study only OPGs of good quality were considered, and analyzed in standardized light conditions with a magnification (x2). However, even if radiographs are a valuable tool to diagnose periapical lesions, they cannot provide, information about the quality of endodontic protocols used and about the quality-system procedures for disinfection of root canals, which is an important factor for a successful treatment as reported by Sjögren (18) The data emerging from this study revealed an incidence of AP in endodontically treated teeth of 41.6%, highlighting the poor quality of endodontic treatments observed. This result agrees with the values observed in other studies: 39.2% (14), 40.4% (7), 44.7% (3), 45% (1), 45.4% (13) and falls within the range shown in the study performed by Georgopoulou et al. (12), where the prevalence of AP in the treated teeth ranged from 21.5% to 64.5%. However, it must be said that the comparison of results with different epidemiological studies conducted on the frequency of AP and endodontic treatments must be done carefully, because of the many methods used (type of radiographs examined, the criteria adopted, the period in which the study was conducted, exclusion criteria).

This study shows a high statistical significance ($p < 0.001$) between periapical status and quality of endodontic treatment and it can be observed that the association between endodontic treatment and AP decreases when root canal filling is 0-2 mm short of the radiographic apex. This result agrees with other studies in literature (7,10). Moreover, statistical data shows that a higher incidence of AP is found in cases where root canal filling ends at a distance greater than 2 mm from radiographic apex (underfilled) or only in the pulp chamber, as shown in several studies (1,19). As far as root canal filling is concerned, statistics show that the percentage of AP increases in cases where the root canal filling is not satisfactory ($p < 0.001$). This is in agreement with what is indicated by Petersson et al. (20), who have shown that an incomplete root canal filling is associated more frequently to the development of periapical lesions in respect to treated teeth in which the filling

is without voids visible by radiographic analysis. Instead Ödesjö et al. (21) and Eriksen et al. (22) did not find significant differences in their studies between the quality of root canal filling and the increased incidence of AP. The results obtained in our study show that another factor for endodontic success is the proper seal of the coronal restoration ($p < 0.001$). As shown by Ray and Trope (23), the use of a good coronal sealing may be more determinant of the implementing rules of endodontic treatment to ensure the health of the periapical region. In conclusion, it appears that the proper cleaning, shaping and filling of the root canal system, as well as the presence of a good coronal seal are key requirements for ensuring the health of the periapical area for a long time. Patients examined in this study do not represent a statistically significant sample of the Italian adult population, but may provide information about the quality of endodontic treatment and the prevalence of AP.



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