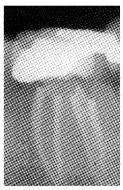
doi:10.1111/j.1365-2591.2007.01217.x



CLINICAL ARTICLE

Cross-sectional evaluation of the periapical status and quality of root canal treatment in a selected population of urban Turkish adults

H. Sunay[1], J. Tanalp[1], I. Dikbas[2] & G. Bayirli[1]

[1]Department of Endodontics; and [2]Department of Prosthodontics, Faculty of Dentistry, Yeditepe University, Istanbul, Turkey

Abstract

Sunay H, Tanalp J, Dikbas I, Bayirli G. Cross-sectional evaluation of the periapical status and quality of root canal treatment in a selected population of urban Turkish adults. *International Endodontic Journal*, **40**, 139–145, 2007.

Aim To investigate the prevalence of apical periodontitis and the quality of root canal treatment in an adult Turkish population who visited a university dental clinic.

Summary The periapical status of 8863 teeth belonging to 375 patients was evaluated by two pre-calibrated observers from panoramic radiographs. The presence of apical periodontitis, and the prevalence and quality of root fillings were recorded. The relationship between the radiographic quality of root fillings and apical periodontitis was examined by chi-squared statisticl-analysis. Of 8863 teeth, 470 (5.3%) had undergone root canal treatment. Forty-seven per cent of all the subjects had at least one root-filled tooth. Periapical radiolucencies were visible on 4.2% of teeth examined, with 53.5% of root-filled teeth presenting apical periodontitis. Ninety-one per cent of root-filled teeth with periapical pathosis were determined to have inadequate root fillings. A statistically significant correlation was found between the quality of root fillings and the presence of apical periodontitis ($P < 0.05$).

Key learning points

- The radiographic quality of root fillings correlated with periapical radiographic signs of pathosis in a selected population of Turkish adults.
- There is a need to improve the standards of root canal treatment in the study population.

Keywords: apical periodontitis, endodontic epidemiology, quality of endodontic treatment.

Received 17 February 2006; accepted 28 September 2006

Correspondence: Dr Hakki Sunay, Faculty of Dentistry, Department of Endodontics, Yeditepe University, Bağdat Caddesi 238, Göztepe-Istanbul, Turkey (Tel.: +90 216 363 60 44; fax: +90 216 363 62 11; e-mail: hakki.sunay@superonline.com).

Introduction

The aim of endodontic epidemiology has been described as gaining knowledge of the distribution and prevalence of apical periodontitis and its determinants including treatment outcome in different populations evaluated by the presence/absence of apical periodontitis (Eriksen *et al.* 2002).

A survey of the literature reveals that most previous studies of endodontic epidemiology have been performed amongst Scandinavian and European populations (Petersson *et al.* 1986, Eckerbom *et al.* 1991, De Cleen *et al.* 1993, Eriksen *et al.* 1995, Marques *et al.* 1998, Kirkevang *et al.* 2001, Lupi-Pegurier *et al.* 2002, Georgopoulou *et al.* 2005, Kabak & Abbott 2005, Loftus *et al.* 2005, Kirkevang *et al.* 2006). Outcomes have varied depending on the study population.

No research has been reported on the prevalence of apical periodontitis associated with root-filled and nonroot-filled teeth in Turkish populations. The primary aim of this cross-sectional study was to analyse the prevalence of apical periodontitis and the quality of root fillings in a selected population of urban Turkish adults who visited a university dental clinic within a specific time interval.

Report

Patients

This study was undertaken by evaluating the periapical status of teeth on panoramic radiographs of clinic patients between the ages of 16 and 82 years, who visited the clinics of Faculty of the Dentistry, Yeditepe University, Istanbul, Turkey between 2004 and 2005. The patient population of the Faculty of Dentistry, Yeditepe University consists of individuals receiving social security whose treatments can be completed free of charge, patients referred from other hospitals as well as patients who are willing to have their treatments completed by specialists. Care was taken to include only those individuals who were able to confirm that they had not received a root filling during the previous 2 years. This rule was adopted to control for subjects in whom early healing responses may be underway following recent endodontic intervention. Panoramic radiographs were taken by the same dental radiologist using the Trophy OrthoSlice 1000 orthopanthomogram device (Asahi Roentgen Ind. Co. Ltd; Minami-Ku, Kyoto, Japan).

Methods

Two endodontic specialists were calibrated by scoring 20 films that were not included in the main study. Third molars were excluded from evaluation. Films were read on an illuminated viewbox (Kavo Dental; Biberach, Germany) in a darkened room with magnification if needed. Scoring criteria were as proposed by De Moor *et al.* (2000):

Root canal treated tooth. Tooth with radiopaque material in pulp chamber and/or root canals.

Periapical status. Parameters used to categorize periapical status were:

1. *Healthy periodontal ligament*: an intact periodontal ligament with no signs of periapical pathosis.
2. *Widening of the periodontal ligament (apical periodontitis)*: widening of the apical part of the periodontal ligament not exceeding two times the width of the lateral periodontal ligament space.

3. *Obvious periapical radiolucency (apical periodontitis)*: periapical radiolucency (radiolucency in connection with the apical part of the tooth exceeding at least two times the width of the lateral part of the periodontal ligament).

Quality of root canal treatment:

1. Root filling 0–2 mm short of the radiographic apex (adequate).
2. Root filling > 2 mm short of the radiographic apex (inadequate).
3. Root filling extruded beyond the radiographic apex (inadequate).
4. Root filling limited to the pulp chamber (inadequate).

Kappa statistics for inter-observer yielded a score of near-perfect agreement (0.91) in terms of periapical scoring. Consensus was reached by dialogue in cases of disagreement. Scoring of the 20 radiographs was repeated after 6 months to confirm intra-observer agreement.

A total of 375 panoramic radiographs were evaluated in the study proper. Data were entered into a spreadsheet for analysis (Microsoft Excel, Microsoft Company, WA, USA).

Statistical analysis

Statistical analysis was performed using the GraphPad 5.0 Prism Pocket Programme (GraphPad Software Inc.; San Diego, CA, USA). Qualitative data were analysed using the chi-squared test.

Results

The radiographs included 8863 teeth in total. One hundred and forty-seven (39.2%) radiographs belonged to male patients whereas 228 (60.8%) belonged to female patients. One hundred and seventy-six (46.9%) of all the subjects had at least one root-filled tooth. The number of missing teeth according to age groups is presented in Table 1. The number of missing teeth per person increased with age and the difference was statistically significant ($P = 0.001$).

The periapical status of one hundred and thirty-two of the 8863 teeth was radiographically nonassessable; thus they were excluded from the evaluation. Twenty-one of the nonassessable teeth had been root filled.

Table 1 Medians and percentiles of the number of remaining and missing teeth according to age groups

	Percentiles						
Age groups (years)	5	10	25	50	75	90	95
Number of remaining teeth							
20–30	18.05	23.9	25.0	26.0	27.0	27.0	27.0
31–40	20.35	22.0	24.0	26.0	26.0	27.0	27.0
41–50	14.6	16.0	19.0	24.0	26.0	27.0	27.0
51–60	11.9	14.9	18.0	21.0	24.0	26.0	26.0
61–70	5.9	9.6	16	19	22.75	26	26.35
>71	6.05	7.0	9.5	15.5	21.75	23.9	25.9
Number of missing teeth							
20–30	1.0	1.0	1.0	2.0	3.0	4.1	9.95
31–40	1.0	1.0	2.0	2.0	4.0	6.0	7.65
41–50	1.0	1.0	2.0	4.0	9.0	12.0	13.4
51–60	2.0	2.0	4.0	7.0	10.0	13.1	16.1
61–70	1.65	2.0	5.25	9.0	12.0	18.4	22.1
>71	2.1	4.1	6.25	12.5	18.5	21.0	21.95

Table 2 Distribution of the examined teeth according to periapical status

Periapical status of teeth	Root-filled teeth *n* (%)	Nonroot-filled teeth *n* (%)	Total *n* (%)
With apical radiolucency	240 (2.8)	134 (1.5)	374 (4.3)
Without apical radiolucency	209 (2.4)	8148 (93.3)	8357 (95.7)
Total	449 (5.2)	8282 (94.8)	8731 (100)

Table 2 demonstrates the distribution of the teeth examined according to the presence of root fillings and periapical radiolucencies. Four hundred and seventy (5.3%) of all teeth had undergone root canal treatment. Three hundred and seventy-four (4.2%) of the radiographically assessable teeth (8731) were associated with periapical radiolucencies. Four hundred and forty-nine (53.5%) of the root-filled teeth had radiographic signs of apical periodontitis. Chi-squared tests showed that the probability of apical periodontitis was significantly higher in teeth with root fillings compared with nontreated teeth ($\chi^2 = 1602.7$, $P < 0.0001$). Furthermore, 37.6% of the subjects had at least one tooth with apical periodontitis.

The distribution of root-filled teeth according to tooth type and the presence of apical periodontitis is presented in Table 3. It was also determined that 270 (57.4%) of the endodontically treated teeth were in the maxilla and 200 (42.8%) in the mandible.

The distribution of root-filled teeth with apical periodontitis according to age groups is shown in Table 4. The incidence of apical periodontitis was the highest between the ages of 41 and 50 years. The lowest incidence was noted among patients between the ages of 61 and 70 years.

The relationship between radiographic quality of root fillings and radiographic signs of apical periodontitis is shown in Table 5. Two hundred and eighteen (90.8%) of root-filled teeth with apical periodontitis had inadequate root canal fillings, the majority of them being short of the radiographic apex. There was a statistically significant relationship between the quality of root fillings and the presence of apical periodontitis ($P = 0.001$, odds ratio 32.5).

Table 3 Prevalence of root-filled teeth and apical periodontitis according to tooth type

Tooth type	Number of root-filled teeth *n* (%)	Number of teeth with normal periapical status *n* (%)	Number of teeth with apical periodontitis *n* (%)	Number of nonassessable teeth *n* (%)
Anterior teeth	148 (31.5)	75 (35.9)	67 (27.9)	6 (28.6)
Premolar teeth	189 (40.2)	88 (38.8)	93 (38.8)	8 (38.1)
Molar teeth	133 (28.3)	46 (33.3)	80 (33.3)	7 (33.3)
Total	470 (100)	209 (100)	240 (100)	21 (100)

Table 4 Distribution of apical periodontitis in root-filled teeth by age

Ages (years)	Root-filled teeth with apical periodontitis, *n* (%)	Root-filled teeth without apical periodontitis, *n* (%)
20–30	39 (18.7)	35 (14.6)
31–40	42 (20.1)	49 (20.4)
41–50	47 (22.5)	48 (20.0)
51–60	42 (20.1)	55 (22.9)
61–70	24 (11.5)	24 (10.0)
>71	15 (7.2)	29 (12.1)
Total	209 (100)	240 (100)

Table 5 Relationship between the quality of root filling and periapical status

Quality of root filling	With apical radiolucency, *n* (%)	Without apical radiolucency, *n* (%)	Total *n*
Adequate	22 (9.2)	166 (79.4)	188
Inadequate	218 (90.8)	43 (20.6)	261
Total	240 (100)	209 (100)	449

$\chi^2 = 223$; $P = 0.0001$, highly significant; OR = 32.25 (22–64.6).

Discussion

The panoramic radiographs included in this study belonged to patients who visited the university clinic for a periodic check-up or required a general radiographic overview prior to a prosthodontic treatment. Similar to many other endodontic epidemiological studies, radiographic evaluation was the only criterion to determine the periapical status of the study population. Teeth with potential problems (e.g. pulpitis, necrosis) without radiographic manifestations were therefore not taken into consideration. The endodontic needs of a study population may thus be under-estimated.

Even though the Consensus report of the European Society of Endodontology advises a 4-year observation period for the assessment of periapical condition (European Society of Endodontology 1994), a period of 2 years was taken as a primary criterion in the present study as it is a more reliable time period when data were recorded from the patient's history and their recall of previous treatment.

The accuracy of panoramic radiographs in the detection of apical periodontitis has been questioned, although Ahlqwist *et al.* (1986) supported their use in epidemiological studies. Whilst acknowledging the issues of nonuniform magnification and poor imaging of anterior teeth, the utilization of panoramic films was preferred in the present study as a large volume of patient data could be readily gathered within the university clinic where the study was conducted and without exposure of participants to further radiation.

It is appropriate at this point to emphasize the fact that cross-sectional studies are limited by the dynamic nature of periapical healing, and long-term follow-up studies may better reflect the outcomes of endodontic interventions (Kirkevang *et al.* 2006). Another possible risk associated with the present investigation is the fact that the records of patients reporting at least 2 years since the last endodontic intervention may have been inaccurate because of skewed recollection. In Turkey's dental healthcare system, there is no possibility of tracing every patient's previous dental records; errors may therefore have arisen in some cases.

Results concerning the gender ratios of the population were similar to those reported by Georgopoulou *et al.* (2005) and may indicate the greater interest of female patients in dental care and attendance for check-ups. The number of extracted teeth per person increased with age and the difference was statistically significant. Maxillary left second premolars and mandibular left molars were most likely to be associated with periapical radiolucencies. The complex root canal anatomy of maxillary second premolars, which may exhibit quite a number of morphological variations, may be a reason for the failure of root canal treatments performed in these teeth (Soares & Leonardo 2003). In addition, mandibular first molars are the first teeth to erupt in permanent dentition and consequently more prone to caries, operative intervention and pulp disease.

Apical periodontitis was most frequently encountered in subjects between the ages of 41 and 50 years and showed a gradual decline in the following years. The age range of 41–50 years is a period when urban Turkish individuals have undergone a number of dental interventions; therefore the incidence of apical periodontitis may be expected to be the

highest during this life period. Subsequent extractions in the following years may lead to a drop in the incidence of apical periodontitis.

It is questionable whether the patient population evaluated in the present study can be representative of the Turkish population in general. In Turkey, most dental specialists are centred in big cities where dental care is more sophisticated. On the other hand, some inferences can be made regarding the current status of a population in a large city. Consistent with previous panoramic radiograph-based studies of urban populations, the results of the present study show a poor technical quality of root canal fillings (De Moor *et al.* 2000, Lupi-Pegurier *et al.* 2002, Kabak & Abbott 2005, Loftus *et al.* 2005).

It is a problem inherent in all epidemiological studies that the quality of root fillings is one of the few prognostic factors that can reliably be recorded (Eriksen *et al.* 1995). However, the radiographic image does not provide any insight into the process or the procedure carried out. The results obtained in the present study indicate a strong inter-relationship between the adequacy of the root filling and the periapical condition. This is consistent with the findings of others (De Cleen *et al.* 1993, Boucher *et al.* 2002, Lupi-Pegurier *et al.* 2002, Loftus *et al.* 2005) and confirms that the technical quality of root filling may play a crucial role in the final outcome of root canal treatment.

Conclusion

Within the limitations of this study, it can be concluded that the technical quality of root fillings in a selected urban adult Turkish population was in general below the acceptable standard and requires substantial improvement.

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