

**RADIOGRAPHIC EVALUATION OF PERIAPICAL STATUS AND FREQUENCY  
 OF ENDODONTIC TREATMENT IN A TURKISH POPULATION:  
 A RETROSPECTIVE STUDY\***

**Türk Toplumunda Endodontik Tedavi Sıklığının ve Periapikal Durumun Radyolojik  
 Değerlendirmesi: Retrospektif Bir Çalışma**

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**ABSTRACT**

**Purpose:** The aim of this study was to determine the frequencies of apical periodontitis and endodontic treatment in a Turkish population using a retrospective analysis of orthopantomograms. **Materials and Methods:** The sample consisted of orthopantomographs of 250 subjects who had been referred to our clinic for an initial visit between the years of 2013 and 2014. The periapical status of all teeth (with the exception of third molars) was examined using periapical index scoring system (PAI). Data were analyzed statistically using the Chi-squared test at the significance level of  $p < 0.05$ . **Results:** The study sample comprised 6196 teeth belonging to 250 patients. Out of 6196 examined teeth, the frequencies of apical periodontitis and endodontic treatment was 1.8% and 3.7%, respectively. Gender had no effect on the presence of apical periodontitis or the frequency of endodontic treatment. The frequency of apical periodontitis and endodontic treatment increased with age, but it did not show statistical significance among different age groups. **Conclusion:** This study provides epidemiological data about apical periodontitis and endodontic treatment in a Turkish population.

**Keywords:** Apical periodonititis; Panoramic radiograph; Periapical index; Endodontic treatment

**ÖZ**

**Amaç:** Bu çalışmanın amacı; Türk toplumunda apikal periodontitis ve endodontik tedavi sıklığını ortopantomografilerin retrospektif analiziyle belirlemektir.

**Gereç ve Yöntem:** Çalışma grubu 2013-2014 yılları arasında ilk muayene için kliniğimize başvuran 250 bireyin ortopantomografisinden oluşmaktadır. Tüm dişlerin periapikal durumları (üçüncü molarlar hariç) periapikal skorlama indeksiyle (PAI) değerlendirilmiştir. Veriler  $p < 0.05$  düzeyinde ki-kare testiyle değerlendirilmiştir.

**Bulgular:** 250 bireye ait 6196 dişten oluşan çalışma grubunda apikal periodontitis ve endodontik tedavi sıklığı sırasıyla %1.8 ve %3.7'dir. Cinsiyet, apikal periodontitis ve endodontik tedavi sıklığına etki etmemektedir. Yaş artışıyla birlikte her ikisi de artış göstermektedir. Ancak, farklı yaş grupları arasında apikal periodontitis ve endodontik tedavi sıklığı yönünden istatistiksel olarak anlamlı farklılık görülmemiştir.

**Sonuç:** Bu çalışma Türk toplumunda apikal periodontitis ve endodontik tedavi hakkında epidemiyolojik bir bilgi sağlamaktadır.

**Anahtar kelimeler:** Apikal periodontitis; Panoramik radyografi; Periapikal indeks; Endodontik tedavi

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## Introduction

Apical periodontitis (AP) is an acute or chronic inflammation process around apex of the tooth (1). This inflammation is frequently asymptomatic and detected primarily on routine radiographic examination. Early-stage apical pathology may be indicated by radiographically visible changes in the lamina dura (2). The main cause of AP is the bacterial invasion that colonize in the root canal which penetrates into the periapical tissues (1). Bacteria and their toxins can reach the pulpal space via dental caries, trauma and/or operative procedures and then they can advance into the periapical tissues, where they meet various factors of the host defense systems (3). AP usually develops after necrosis of the pulp and is frequently detected in connection with endodontically treated teeth (1). Amongst oral infectious diseases, AP is, after caries, the most prevalent oral infection both in USA and Europe (4). Epidemiological studies which have been carried out in different population groups have shown that root-filled teeth (RFT) have a greater prevalence of AP than non-treated teeth (5) and there is a high prevalence of AP in connection with RFT ranging from 16% to 65% (6). Frequency of AP range from 1.4% to 8.0%, when the tooth is considered as an individual unit. On the other hand, when subjects are considered in total, the prevalence of AP can be as high as 70% (5, 7). Reports indicated that the prevalence of root canal treatment varies from 1.3% to 20% which increases with patient age. Previous studies also showed that when root canal treatments are evaluated radiographically, they are judged to be insufficient in a large proportion of cases (6).

The success rate of root canal treatment is a public health problem that have medical, financial and ethical repercussions (6). Establishing clear treatment objectives and improving techniques will enable practitioner to expect a high success rate (6, 8). Follow-up clinical studies have shown that root canal treatment procedures which conform with modern principles of practice, leads to the favourable results with healing rates above 90%. Such high rates of success were obtained with well trained practitioners under strict operating conditions. That may not reflect the real situation found in general practice (6). Relatively few data have been collected recently regarding the frequency of root canal treatment and periapical lesions in Turkish population (9). Therefore, the objective of this study was to determine the frequency of endodontic treatment and apical periodontitis in a Turkish population.

## Materials and Methods

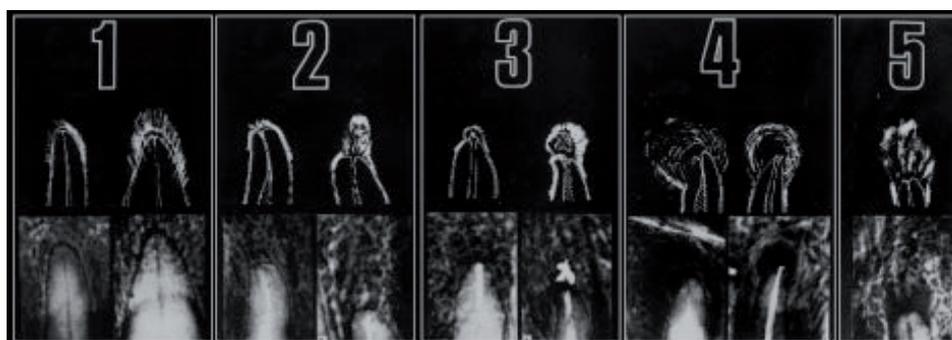
### Study Population

Research protocol was approved by the Ethical Committee (Project no: 2015/358). The study sample was collected from the dental records of the Selcuk University Faculty of Dentistry and consisted of orthopantomographs (OPGs) of 250 subjects (125 males and 125 females, in five age groups of 10 year intervals, within 50 individuals per group female / male: 1/1) who had attended for an initial visit between the years of 2013 and 2014 years. Each subject had an OPG taken during the routine examination. Individuals younger than 15 years and those with 7 or less remaining teeth were excluded from the study participation. [Because they often had periodontal disease and it was impossible to determine the role played by the endodontic treatment in the occurrence of a periapical radiolucency (10, 11)].

### Radiographic Examination

All OPGs were obtained using digital devices (Kodak® 8000, Rochester, New York, USA) by the same radiographer according to exposure parameters suitable for the patient's gender, age and weight. Poor-quality OPGs, including under- or over-exposed images, those with blurred anterior regions and those obviously affected by patient movement, were excluded from the analysis. Missing and root filled teeth were recorded from the panoramic survey. The periapical status of all teeth (with the exception of third molars) was examined using periapical index scoring system (PAI), proposed by Ørstavik *et al.* (12) (Figure 1). PAI is based on the use of reference radiographs with verified histological diagnosis and is composed of five categories as follows:

- 1) Normal periapical structures or normal apical periodontium,
- 2) Small changes in periapical bone structure or bone structural changes indicating, but not pathognomonic for apical periodontitis,
- 3) Changes in periapical bone structure with some mineral loss or bone structural changes with some mineral loss characteristic of apical periodontitis,
- 4) Demineralization of periapical bone with well-defined radiolucent area or well-defined radiolucency,
- 5) Demineralization of periapical bone with exacerbating features or radiolucency with radiating expansions of bone structural changes.



**Figure 1.** Visual references used for the evaluation of the roots using the Periapical Index (PAI) score system as proposed by Ørstavik et al. (12).

Scores 1 or 2 indicated healthy teeth whereas scores 3 to 5 indicated the presence of AP. For multi-rooted teeth, the root with the highest PAI score was recorded. Teeth were categorized as endodontically treated if they had been obturated with a radio-opaque material in the pulp chamber and/or in one or more of the root canals. All radiographs interpreted in this study were examined by the same observer, who had three years of oral radiology experience. Two months after the first examination, all radiographs were evaluated again to determine intra-examiner agreement with regard to the detection of periapical radiolucency. Kappa coefficient was calculated to rate the level of intra-examiner agreement.

#### Statistical analysis

All statistical analysis were performed using the SPSS software (ver. 21; SPSS, Inc., Chicago, IL, USA). Categorical data were assessed by chi-square test and the significance level was  $p < 0.05$ .

#### Results

Cohen's kappa coefficient for intra-examiner agreement was calculated as 0.88 which indicates high intra-observer agreement level. The study sample comprised 6196 teeth belonging 250 patients (125 males and 125 females). A mean of 24.8 (range: 8-28) teeth were examined per subject. Age range of the subjects was 15 to 82 (mean: 37) years. Out of 6196 examined teeth, the frequency of AP and RFT was 1.8% and 3.7%, respectively. Overall, 43% of the subject had at least one RFT and 26% exhibited at least one AP. Of the 6196 teeth examined, 3.7% had been root-filled, and of these 15.5% exhibited an AP (PAI>2). Gender had no effect on the presence of AP or the frequency of endodontic treatment. The frequency of AP and endodontic treatment increased with age but it was not significant when different age groups are compared. The age and gender distributions of examined teeth stratified by the apical status and endodontic treatment are shown in Table 1 and Table 2.

**Table 1.** The age distribution of examined teeth according to apical status and endodontic treatment (AP; apical periodontitis).

Age group AP	Number of treatment	Number of endodontically treated teeth with or without AP	Number of teeth with AP with or without endodontic present teeth
≤20 years	1389	26 (1.8%)	12 (0.8%)
21-30 years	1354	43 (3.1%)	18 (1.3%)
31-40 years	1258	55 (4.3%)	18 (1.4%)
41-50 years	1210	55 (4.5%)	26 (2.1%)
50+ years	985	52 (5.2%)	38 (3.8%)
<b>Total</b>	<b>6196</b>	<b>231 (3.7%)</b>	<b>112 (1.8%)</b>

**Table 2.** The gender distribution of examined teeth according to the apical status and endodontic treatment (AP; apical periodontitis).

Gender	Number of present teeth	Endodontically treated teeth with or without AP	Number of teeth with AP with or without endodontic present teeth
Female	3074	125 (4%)	42 (1.3%)
Male	3122	106 (3.3%)	70 (2.2%)
<b>Total</b>	<b>6196</b>	<b>55 (4.3%)</b>	<b>18 (1.4%)</b>

## Discussion

Radiographic information obtained from devices such as periapical, panoramic, RVG and CBCT can be used in an epidemiologic study (13). Some researchers (14-17) have used periapical radiographs whereas others (10, 11, 18, 19) panoramic radiographs for periapical evaluation. As full-mouth periapical radiographs are not used routinely in our dental school, the present study relied on OPGs, which allowed the collection of a large volume of patient data in university clinics without exposing study participants to excessive radiation (2, 9, 20). Also, modern panoramic radiography devices produce better-quality radiographic images, even in the anterior region (2, 21). Some authors (22, 23) concluded that using OPG in epidemiological studies is acceptable and the difference between periapical and panoramic radiographs for the detection of AP was not statistically significant. The panoramic radiographs are simple and fast enough to be used in patients who have limited mouth opening. They also have a high specificity (86%) and sensitivity (96%) for the detection of periapical pathology. Therefore, OPGs are acceptable alternatives in epidemiological studies on dental health, although it was shown that the periapical radiographs provide better visibility except for maxillary second and third molar teeth (24).

Considering that AP lesions which are confined to cancellous bone might go undetected in radiographic examination, more sensitive techniques can be used in further studies. One of these methodologies is CBCT (25). Implementation of periapical index to CBCT to identify AP, offers an accurate diagnostic method that produces high-resolution images. This approach can reduce the prevalence of false-negative diagnosis, minimize observer interference and increase the reliability of epidemiologic studies (21). Although being more precise and sensitive, these systems carry the disadvantage of exposing patients to relatively higher level of ionizing radiation (25). Well-designed epidemiological research is based on the use of pre-defined criteria for the conditions under investigation

as well as proper training and calibration of the investigators (7). Although no standard criteria has been defined for the registration of AP in epidemiologic surveys for periapical or panoramic radiographs, the PAI scoring system has been modified and was applied to epidemiologic and clinical studies that focus on the treatment outcome (26). It is considered as the most acceptable method to determine the periapical status in epidemiological studies (27). It provides a pre-defined set of criteria that fulfill the following requirements: measurable, mutually exclusive, valid, reproducible and communicable (7, 13). The PAI was first described for periapical radiographs (5, 26, 28), but numerous epidemiologic studies have used this index for panoramic radiographs or for both techniques simultaneously as well. (26). The AP frequency we found in our population (1.8%) was lower than that of the selected populations of the other studies which have been conducted in different countries (5, 8, 18, 21, 29). On the other hand, the frequency of RFT we observed in this study was 3.7% and this was within the findings reported (2.0% - 21%) in previous studies (1, 6, 8, 18, 21, 29, 30). The frequency of AP in RFT was lower (15.5%) than that of the previous studies (25% - 64.5%) (2, 5, 6, 8, 18, 29, 30). This low AP frequency could be related to the frequent extraction of teeth with periapical disease and even with pulpitis, due to the relatively small number of specialists in endodontics in this region of Turkey (27). Most dental specialists are concentrated in big cities in Turkey where more sophisticated dental care can be reached easily. Thus, it is questionable whether the patient population evaluated in the present study can be representative of the Turkish population in general (31). It is appropriate to mention that the general patient profile of our hospital consists of individuals with rather insufficient and limited socioeconomic status. So, unfortunately, individuals with such background often prefer to have their teeth extracted rather than to have endodontic treatment.

The concept of endodontically preserving natural teeth is just beginning to emerge in this community. This concept is not new to other countries or

communities. The incidence of endodontic treatment will definitely increase in the upcoming years as public awareness on this issue also increases (25).

There are several epidemiological studies about AP and RFT frequency (Table 3). The differences between countries can be partially related to the health care systems (11, 30). For example, Japan has a compulsory insurance system, and all those living

in Japan are covered by some form of insurance. This might contribute to the high prevalence of root canal treatment seen in Japanese population. Moreover, the cost of root canal treatment has also an effect on the preference of this treatment option (30).

**Table 3.** Findings of previous studies on apical periodontitis (AP) and root-filled teeth (RFT) frequencies.

Author	Year	No. of teeth	Teeth with AP	Teeth with RFT	Population
Kirkevang <i>et al.</i> (29)	2001	15984	3.4%	4.8%	Danish
Jimenez-Pinzon <i>et al.</i> (5)	2004	4453	4.2%	2.1%	Spanish
Sunay <i>et al.</i> (31)	2007	8863	4.2%	5.3%	Turkish
Gulsahi <i>et al.</i> (20)	2008	24433	1.4%	3.3%	Turkish
Kamberi <i>et al.</i> (3)	2011	4131	12,3%	2.3%	Kosovar
Peters <i>et al.</i> (21)	2011	4594	7%	4.8%	Dutch

The lack of standardized criteria to assess the frequency of AP and RFT in several published articles, establishing the correct level of measure unit (subject, tooth or root filled-tooth) create difficulties in comparing the outcomes of previous research with the present study. Variations in sampling procedures, type of radiograph examined and heterogenous samples, especially regarding the age of participants, are other probable sources of inconsistency (7). When samples obtained from Turkey are considered alone, frequency of AP (1.8%) of the present study was close to Gulsahi *et al.* (20) (1.4%) and Özbaş *et al.* (25) (1.63%) but lower than Sunay *et al.* (31) (4.2%). The RFT frequency found in this study (3.7%) was consistent with Gulsahi *et al.* (20) (3.3%) and was within the range described by Özbaş *et al.* (25) (1.55%) and Sunay *et al.* (31) (5.3%).

The discrepancies may have been caused by methodological differences or by changing the number of the extracted teeth with AP due to an inadequate endodontic treatment and apical pathology (6, 20). Thus, the results might vary from those obtained from another population of the same country (20). Considering the design of the present study, the radiographs were examined at a single time point and no information was available regarding when the endodontic treatments are performed. Therefore, it was not possible to determine whether a periapical lesion is healing or not (11, 17, 25, 31, 32). According

to our findings, the frequencies of AP and endodontic treatment increased with age, which is in accordance with some researchers (2, 29) but it did not show statistical significance among different age groups. This increase may be a cumulative effect resulting from longer exposure to function, caries, and iatrogenically derived pathologic conditions (8). Age-related changes of the dental pulp complex were well-described and influence the frequency of the endodontic treatment in elderly patients (7). Moreover younger people tend to visit the dentist more often when compared to elderly and thus they have a lower incidence of caries and periodontal diseases (3). The results of the present study showed that gender had no effect on frequency of RFT or AP. However, in some epidemiological studies, gender was reported to have an effect on the number of RFT or the presence of AP related to female predominance (17, 31). The authors (17, 31) claimed that this result may indicate the greater interest of female patients to have dental care and their regular attendance for check-ups.

### Conclusion

This study provides an epidemiological data about AP and root canal treatment in a Turkish population; however, a radiograph provides only static information of a dynamic process. Therefore, a periapical lesion may either be increasing in size

or healing. The frequencies of AP and RFT were found to increase with age, probably because of the longer exposure to caries and having subsequent dental procedures. Further studies of dental health involving larger samples that cover wider regions of Turkey will help to identify public dental health problems which will constitute an essential step in improving the general health status of the citizens of this country.

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#### Conflict of interest

None declared

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