



A cross-sectional study of the periapical status of teeth and quality of root canal treatment in a selected population of young Turkish and foreigners living in Türkiye

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Purpose: The objective of this study was to assess the quality and state of treatment for teeth with periapical lesions (PLs) in a group of young Turkish and international residents living in Türkiye.

Methods: Patients between the ages of 18 and 30 whose digital orthopantomography (OPTG) was taken between January 2018 and January 2023 were evaluated. Gender, age, nationality, the number of teeth present, the number and location of endodontically treated teeth, the number of teeth with PL, periapical status, and the standard of root canal treatment (RCT) were all employed and recorded. This study had 393 foreign patients. The same number of Turkish patients was chosen by systematic sampling from the 30405 Turkish patients.

Results: The OPTGs of 786 patients including 21126 teeth were evaluated. The average age of patients was 23. The number of teeth with RCT was 1100 teeth (5.2%). In the Turkish population, 10668 teeth were examined; RCT was present in 332 teeth (3%), of which 221 (66%) had PL. In the foreigner population, 10458 teeth were examined; RCT was present in 768 teeth (7%), of which 477 (62%) had PL. In Turkish and foreign patients, molars (58%) were the most commonly treated teeth with PL. The working length of RCT was adequate for 50% of teeth in the Turkish population and 48% of teeth in the Foreigner population. 44% of teeth in Turkish population and 32% in foreigners with periapical lesions had not undergone to RCT.

Conclusion: In both populations, molars were the most endodontic-treated teeth. The quality of RCT in an included young Turkish population and foreigners was in general underneath than appropriate standard.

Keywords: Apical periodontitis; periapical lesion; radiographic quality of endodontic treatment.

Introduction

The primary aim of endodontic treatment is to prevent and protect periapical tissues from inflammation (1). Untreated non-vital teeth can cause gradually increasing infections that affect the structural changes in periapical tissue, which

has a dynamic response of host defense. Therefore, the widening of periodontal ligament can be seen in conventional radiographic methods (2,3). The presence of a persistent periapical radiolucency after root canal treatment is regarded as an unfavorable outcome, whereas the resto-

Cite this article as: Koç S, Tekinarslan D, Er K. A cross-sectional study of the periapical status of teeth and quality of root canal treatment in a selected population of young Turkish and foreigners living in Türkiye. Turk Endod J 2023;8:137-142.

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Submitted: August 17, 2023 Revised: October 09, 2023 Accepted: October 10, 2023

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ration or emergence of a normal periodontal ligament is seen as a desirable result (1).

Cross-sectional studies (4,5) performed in European countries carried out in university hospitals have revealed that the prevalence of periapical lesion (PL) in teeth with root canal treatment (RCT) is usually high (30–65%). Although the prevalence of teeth with RCT and the quality of endodontic treatment varied in these studies, PL is mostly related to inadequate root filling and inappropriate coronal restorations (6). The objective of endodontic epidemiology is to acquire an understanding of the distribution and prevalence of apical periodontitis, along with its determinants, including treatment outcomes, in diverse populations assessed based on the presence or absence of apical periodontitis (7).

The most studied endodontic epidemiology has been reported from Scandinavian and European populations (8,9). These epidemiology outcomes can be directly affected by the study population. In the literature, there is no previous study comparing the prevalence of apical periodontitis and the quality of RCT between young Turkish and foreign populations. This radiographic-based cross-sectional study aimed to analyze the prevalence of apical periodontitis and the quality of root canal treatments in a selected population of young Turkish and foreigners. The null hypothesis was that there was no difference between these two populations in the aspect of the prevalence of PL and the quality of RCT.

Materials and Methods

The Clinical Research Ethics Committee of Akdeniz University, Türkiye reviewed and approved the study construction with decision number KAEK-397 on May 10, 2023.

Before the study, two endodontists evaluated 20 orthopantomography (OPTGs) for calibration and these films were not included in this study. The intercorrelation between two examiners was highly consisted.

Inclusion and Exclusion Criteria

The digital OPTGs acquired from the patient file repository at the Akdeniz University Faculty of Dentistry (located in Antalya, Türkiye) were assessed. These OPTGs were captured during diagnostic and planning procedures spanning from January 2018 to 2023. From this collection, OPTGs of patients aged between 18 and 30 years, who had undergone an initial examination at the dental school during this period, were chosen. Examination did not encompass third molars.

The following data were recorded for each patient: Gender, nationality, age, number of teeth present, the number of teeth with PL, number and location of endodontic

treated teeth, periapical status, quality of RCT, number of teeth with deep dentin decay, the number of teeth with broken endodontic file, and restoration type of the teeth. Impacted teeth were excluded, as well as third molars, giving a maximum of 28 teeth per dentition. All the foreign patients (a total of 393 foreign patients) who met the accepted criteria were included in this study. The same number (393) of Turkish patients was selected by systematic sampling among a total of 30,405 Turkish patients. Foreign patient's nationalities listed as Afghanistan (26), Albania (1), Algeria (1), Argentina (1), Australia (1), Azerbaijan (45), Bangladesh (1), Belarus (1), Bulgaria (3), Brazil (1), Bosna Hersek (1), China (5), Croatia (1), Egypt (5), England (1), Georgia (3), Germany (1), Ghana (1), Guinea (2), Indonesia (2), Iran (25), Irak (5), Israel (1), Jordan (2), Kazakhstan (31), Kirgizstan (32), Lebanon (1), Lithuania (1), Macedonia (5), Mongolia (1), Morocco (5), Nigeria (2), Norway (1), Pakistan (5), Philippines (6), Poland (1), Romania (2), Russia (29), Sudan (6), Somalia (5), Syria (43), Tanzania (1), Tajikistan (5), Thailand (3), Tunis (3), Turkmenistan (14), Uganda (2), Ukraine (33), Uzbekistan (12), Vietnam (1), and Yemen (3).

Examination of the Radiographs

The following factors were used to categorize periapical status, in accordance with the methodology described in the study by De Moor et al. (10):

1. A healthy periodontal ligament is one that is unbroken and shows no signs of periapical pathosis.
2. Widening of periodontal ligament (apical periodontitis): Widening of the apical section of the periodontal ligament, which should not be wider than twice the breadth of the lateral periodontal ligament space.
3. Obvious periapical radiolucency (apical periodontitis): Radiolucency is immediately next to the apical portion of the tooth and extends to a size that is at least twice the breadth of the lateral periodontal ligament.

According to the following parameters, the effectiveness of root canal therapy was evaluated:

1. An adequate root filling that ends 0–2 mm before the radiographic apex.
2. Insufficient root filling (>2 mm short of radiographic apex): The root filling is finished more than 2 mm before the radiographic apex.
3. Poor root filling (extending beyond radiographic apex): The root filling protrudes past the radiographic apex.
4. Inadequate root filling (limited to pulp chamber): The pulp chamber is the only place where the root filling is present.

Statistical Analyses

The Statistical Package for the Social Sciences, Chicago, IL, USA, version 20, was used to analyze the data. The Chi-square test was used to look at the relationships between periapical health of teeth, quality of root canal fillings, and nationality. This test was also used to evaluate the relationship between the kind of teeth and both RCT and PL. To determine statistical significance, the significance threshold was fixed at 0.05.

Results

In this study, the OPTGs of 786 patients including 21,126 teeth were evaluated. The average age of patients was 23. The female population was 56% for Turkish patients and 58% for foreigners. In the Turkish population 164 (41%) and in the foreigner population, 253 (64%) of the patients had at least one RCT. The number of patients having at least one deep dentin decay was 275 (69.9%) and 248 (63.1) for Turkish and foreign patients, respectively.

Table 1 lists the number of root-filled teeth that were classified as sufficiently filled, inadequately filled, overfilled, and filled within the pulp chamber. There is no difference between Turkish and foreigner population in terms of the

quality of RCT when nationalities are taken into consideration ($p = 0.231$). For 49.4% of the teeth in the Turkish population and 49.5% of the teeth in the foreigner population, respectively, the working length of RCT was sufficient.

In terms of teeth with RCT and PL combined, there is no discernible difference between Turkish and foreign patients. In 10 of these teeth in Turkish populations and 16 of these teeth foreigner population, a piece of a broken file was found in the root canal. In the Turkish population, 10,668 teeth were examined; RCT was present in 336 teeth (31.4%) and 221 (6.5%) of them had PL. In the foreigner population, 10,458 teeth were examined; RCT was present in 748 teeth (7.1%), of which 477 (4.5%) had PL. The number and the percentage of teeth with PL with or without RCT are shown in Table 2. There was a significant difference in the comparison of lesioned teeth with or without root canal treatment between Turkish and foreign patients ($p = 0.001$). While the number of untreated lesioned teeth was significantly higher in Turkish patients, the number of treated and lesioned teeth was significantly higher in foreign patients.

The distribution of the type of tooth with RCT according to Turkish and foreign populations is given in Table 3. In

Table 1. Comparison of RCT quality according to nationalities

	Quality of RCT				p-value	Total
	1	2	3	4		
Nationality						
Turkish	166 ^a (30.9%)	152 ^a (32.6%)	4 ^a (33.3%)	14 ^a (20.3%)	0.231	336
Foreigner	371 ^a (69.1%)	314 ^a (67.4%)	8 ^a (66.7%)	55 ^a (79.7%)		

Table 2. Multiple comparison test of groups

	Nationality		p-value
	Turkish	Foreigner	
PL*			
Teeth with RCT* n (%)	221 ^a (44.6%)	477 ^b (68.2%)	0.001
Teeth without RCT n (%)	274 ^a (55.4%)	222 ^b (31.8%)	

*PL: Periapical lesion.

Table 3. Distribution of teeth in study according to their location

Type of teeth	Nationality		p-value
	Turkish n (%)	Foreigner n (%)	
Anterior	30 ^a (13.6%)	84 ^a (17.6%)	0.265
Premolar	62 ^a (28.1%)	113 ^a (23.7%)	
Molar	129 ^a (58.4%)	280 ^a (58.7%)	

*PL: Periapical lesion.

Table 4. The distribution of the type of restoration in teeth with RCT and PL

Type of restoration	Nationality			
	Turkish n (%)		Foreigner n (%)	
Crown	24	10	106	22
Prefabricated post and crown	4	1	30	6
Prefabricated post and filling	4	1	44	9
No restoration	20	9	51	10

PL: Periapical lesions.

both populations, molars (58%) were the most commonly treated teeth with PL ($p = 0.265$).

The distribution of the restoration type for the teeth with RCT and PL is presented in Table 4. Direct restorations were the most preferred type of restoration for Turkish and foreign patients with 76% and 51% percent, while 9% and 10% had no restoration (the restoration material was not visible in the cavity on OPTG) at all.

Discussion

In this study, OPTGs taken from patients at 18–30 years old as a part of diagnostic and planning procedures between January 2018 and January 2023 at the Faculty of Dentistry, Akdeniz University (Antalya, Türkiye), were assessed. Because Antalya has many populations of diverse nationalities, there is a large pool of information on these foreign patients and there is an opportunity to compare the periapical status of Turkish patients and foreigners. To the best of our knowledge, there is no previous study in the literature that makes this comparison.

The gender ratio of both populations was similar to the previous studies (11,12), 56% in Turkish and 58% in foreign patients, indicating that female patients have a greater interest in dental care and attendance in check-ups. In the previous studies (5,13) conducted in the Turkish population, the reported number of patients who had at least one root-filled tooth ranged between 47% and 61.4%. In this study, almost half of the patients have at least one RCT both in Turkish in foreign patients. Furthermore, among 786 patients, 274 Turkish and 248 foreign patients had at least one deep dentin caries.

Different thresholds have been established in earlier research using different criteria to evaluate the periapical condition and quality of root canal fillings. Only the length of the root fillings has been the subject of certain studies (5,10,14). Others have used duration, homogeneity, and their recordings in combination (4,15). The literature is in agreement that the outcome of non-surgical root canal treatment is greatly influenced by the length of the root filling (5,10). Comparatively simpler than determining its

density is comparing the root filling's length to the radiography apex. The proper assessment of root canal obturation is hard due to the two-dimensional representation of three-dimensional structures provided by radiographic imaging. As a result, the evaluation of quality in this study followed the guidelines provided by De Moor et al. (10). In the present study, 50.5% of teeth with RCT had insufficient treatment, compared to 49.5% who had adequate treatment. Although greater than the study by Touré et al. (16), (17.7%) these findings are consistent with earlier research. When nationalities were considered in the evaluation of RCT quality, there was no discernible difference between Turks and foreigners.

In prior studies (8,17,18), it was noted that molar teeth were the most commonly treated with RCT, a finding that aligns with the results of this study, where the molars with RCT and PL constituted 58% of the total cases. In addition, this study, which included participants from various countries, discovered no appreciable differences between the groups of teeth with RCT and PL. Due to their early appearance in the oral cavity and the complex anatomical features of their occlusal surfaces, they are more prone to tooth decay, which is likely what is causing this trend (19). The results of RCT in normal dentistry practice were also examined in a study by Laukkanen et al. (20). When compared to incisors and pre-molars, their research showed that molars had the worst results. This was clear from the way that the root canal filling was done technically and from how well PL healed.

Significant differences were observed regarding PLs in teeth without RCT compared to teeth with RCT. Notably, the Turkish population exhibited a higher prevalence of PL that was not associated with existing RCT. This observation may be attributed to factors such as limited access to dental care and a lack of interest in seeking treatment. In Türkiye, dental services are primarily concentrated in urban areas, particularly at state or university hospitals. Consequently, residents in rural regions often face challenges in accessing dental care (21,22). This suggests a need for improved referral systems and increased availabil-

ity of primary endodontic treatment for the Turkish population. However, when evaluating the quality of existing RCT, no significant differences were found between the Turkish and foreign populations.

Only a small proportion, 10% of the teeth with both RCT and PL were found to lack coronal restorations. Fillings made up the majority of the restorations. The effectiveness of RCT and the effect of coronal restorations on periapical tissues have been the subject of numerous studies in the literature. According to Kirkevang et al. (23), PL was more likely to occur when root filling and coronal restoration were not performed properly together. Hommez et al. (24) stressed the significance of both appropriate root filling and coronal repair for effective RCT, lending support to this contention. It is significant to highlight that in Türkiye's dental health-care system, it is not feasible to track down every patient's entire dental records. In some situations, this might result in dentists making mistakes in their tracking or raising questions regarding a patient's teeth's prior state. Consequently, it is not possible to directly attribute the presence of PL solely to the failure of coronal restorations. Insufficient information is available regarding when the coronal restorations failed and their specific impact on the root canal.

Cross-sectional studies involve observing a group of participants at a specific point in time. However, these studies have inherent limitations. First, there is a lack of information regarding the time that has passed since the completion of RCT and any associated patient complaints. In addition, relying solely on panoramic radiographic images for screening has limitations, as PL confined to the cancellous bone may go unnoticed. Moreover, cross-sectional radiological examinations do not provide insights into the previous condition of periapical tissues or the state of the root canal system. The foreign patients included in this study were those who had not received dental treatment at our university before and who did not have Turkish citizenship. However, it is not known where these patients had RCT. It should be noted that this study specifically focused on individuals aged 18–30 years, and the findings may be influenced by the fact that RCT and PL are more commonly observed in the elderly population. Finally, as with previous studies, relying solely on radiological evaluations without clinical observations may not always yield reliable data.

Conclusion

In both populations, molars were the most endodontic-treated teeth. The quality of RCT in a sample of the Turkish community and among foreigners was generally subpar. Although RCTs were seen as adequate on the OPTGs

since these radiographs provide two-dimensional examination and the isolation and irrigation procedures used during RCT were not known, a complete conclusion cannot be reached about the quality of RCT.

Authorship Contributions: Concept: S.K., K.E.; Design: S.K., K.E.; Supervision: S.K, K.E.; Materials: S.K., D.T.; Data: S.K., D.T.; Analysis: S.K, D.T., K.E.; Literature search: S.K, D.T.; Writing: S.K, D.T.; Critical revision: S.K., K.E.

Source of Funding: None declared.

Conflict of Interest: None declared.

Ethical Approval: The study protocol was approved by the Akdeniz University Faculty of Dentistry Clinical Research Ethics Committee (date: 10.05.2023, protocol no: KAEK-397).

Informed consent: Written informed consent was obtained from patients who participated in this study.

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