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Endo-Perio Lesions and Dentists' Treatment Approach: A Survey

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Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Background: Endo-perio lesions are a great challenge for dentists. The aim of this study was to evaluate the treatment approach of dental practitioners to endo-perio lesions by considering the current endo-perio classification.

Material/Methods: An online survey was prepared, consisting of questions about the treatment approach to 3 simulated cases with endo-perio lesions, shown on periapical radiography. Details of the patient's age, presence of systemic disease, smoking, and how the single- or multi-rooted tooth would affect the treatment plan were also included in the simulated cases presented in the survey. The survey was sent to 1500 dentists via e-mail, WhatsApp, and social media platforms. The chi-square test was used for comparison of data. Significance was evaluated at $P<0.05$.

Results: In total, 338 dentists participated in the survey, including general dentists, endodontists, and periodontists. Fifty-three percent of participants stated that they would perform root canal treatment and initial periodontal treatment simultaneously, when both treatments were required. In cases classified as grade 3, most general dentists, endodontists, and periodontists answered that they would prescribe systemic antibiotics if there was diffuse extra-oral swelling ($P<0.05$). Moreover, in grade 3 cases, more general dentists chose the option "extraction" as the best choice, compared with endodontists and periodontists, who did not choose extraction as often ($P<0.05$).

Conclusions: According to the results of this study, general dentists, endodontists, and periodontists generally follow different approaches to endo-perio lesions. A consensus is needed on this issue to develop a successful multidisciplinary approach to endo-perio lesions.

Keywords: Clinical Protocols • Endodontics • Periodontal Diseases

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Introduction

The relationship between pulp and periodontal disease was first reported by Simring and Goldberg in 1964 [1]. Pulpal and periodontal tissues are interconnected anatomically, embryonically, and functionally. Anatomical formations, such as dentinal tubules, apical foramen, and lateral canals, are the primary pathways that permit transmission of pathogens between pulpal and periodontal tissues [2]. Endo-perio lesions (EPLs) can be described as pathological changes involving pulpal and periodontal tissues [3]. Epidemiological data are lacking about EPLs. Ruetters et al reported that the prevalence of EPLs was 0.4% in teeth and 4.9% in patients in a sample of 18 963 teeth in 866 patients [4]. The prevalence of EPLs is low, when comparing with other dental diseases, such as periodontitis and caries. This may be the reason for the little data that have been published on this topic [4]. Management of EPLs can be challenging for clinicians, as both tooth and periapical tissues are affected by the infection [5] and because root canal treatment (RCT) and periodontal treatment (PT) should be completed to achieve a successful clinical outcome. The clinical treatment procedure of EPLs is difficult, including the meticulous sequence of procedures and selection of the proper materials [6]. Moreover, the prognosis of the teeth with EPLs is less predictable due to the multi-factorial features of the disease [7]. Schacher et al [8] stated that the 5-year survival rate was 61% in treated teeth with EPLs, and Kim et al [9] reported a treatment success rate of 77.5% in such teeth. Although these rates can be considered relatively acceptable, they remain quite below the success rates of RCT, which was reported to reach up to 98% [10].

Endodontic and periodontal diseases can present with very similar symptoms, making diagnosis difficult [11]. Obtaining a definitive history and a correct diagnosis is of utmost importance for successful treatment of EPLs [5]. An accurate diagnosis also helps to determine the sequence and type of treatment required [12]. Furthermore, a clinician's competence in categorizing the lesion plays an important role in developing a precise and clear treatment strategy [13]. Classification of diseases allows valid grouping of circumstances by etiology, pathogenesis, or severity. Classification also standardizes treatment options based on consistent information and diagnoses and allows valid communication between clinicians [11]. The most-used EPL classification is that defined by Simon et al [14]. This classification is based on the etiology of the lesion and includes primary endodontic lesions, primary periodontal lesions, and combined lesions (primary endodontic lesion with secondary periodontal involvement, primary periodontal lesion with secondary endodontic involvement, and true combined lesions) [15]. Usually, primary endodontic lesions and primary periodontal lesions are easily diagnosed, and successful treatment can be achieved with only RCT or PT, respectively. On the other hand, management of combined EPLs is more demanding, as it requires both RCT and PT. Pulp vitality and extent of the periodontal defect are the most important factors that should be considered while making the treatment plan [16]. However, there have been controversial reports on the optimum sequence and timing of RCT and PT of combined EPLs [17]. Ardila and Builes suggested simultaneous RCT and PT of EPLs [18]. However, when the root canals are infected, some researchers suggest performing RCT before any PT, to eliminate the intracanal infection before any cementum is removed [12]. In a case report study of Karanukar et al, when managing EPLs, the teeth were first endodontically treated, and PT was performed 3 months later [19]. In a retrospective case series, other researchers reported a 6-month follow-up period for a further therapy decision after RCT [20]. Although a sufficient time for tissue healing is recommended before reevaluation for further PT [20], it was not stated how this period was determined in the above-mentioned studies.

Herrera et al formulated a new classification in 2017 (**Table 1**), and in this new concept, the clinical modality has been changed

Table 1. New endo-periodontal lesion classification.

Endo-periodontal lesion with root damage	Root fracture or cracking	
	Root canal or pulp chamber perforation	
	External root resorption	
Endo-periodontal lesion without root damage	Endo-periodontal lesion in periodontitis patients	Grade 1 – Narrow deep periodontal pocket in 1 tooth surface
		Grade 2 – Wide deep periodontal pocket in 1 tooth surface
		Grade 3 – Deep periodontal pockets in more than 1 tooth surface
	Endo-periodontal lesion in non-periodontitis patients	Grade 1 – Narrow deep periodontal pocket in 1 tooth surface
		Grade 2 – Wide deep periodontal pocket in 1 tooth surface
		Grade 3 – Deep periodontal pockets in more than 1 tooth surface

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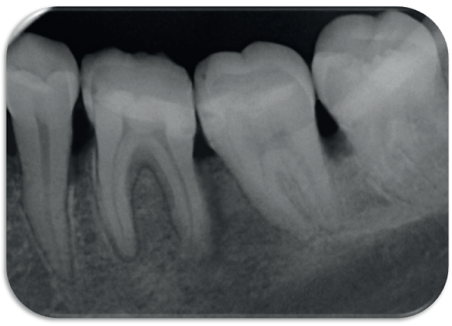

Figure 1. Case 1: Narrow deep periodontal pocket in 1 tooth surface.

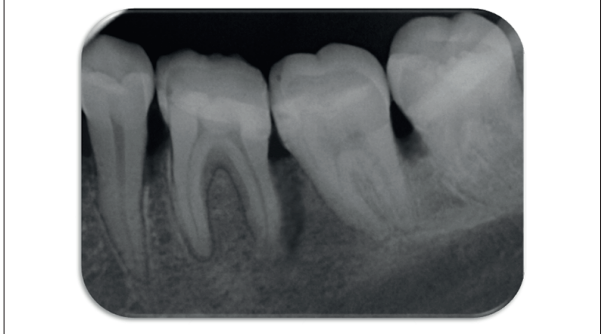

Figure 2. Case 2: Wide deep periodontal pocket in 1 tooth surface.

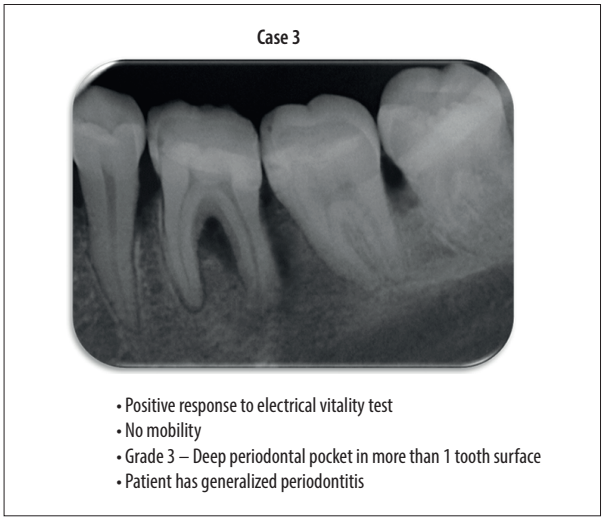

Figure 3. Case 3: Deep periodontal pockets in more than 1 tooth surface.

because the primary origin is not related to treatment [21]. To the best of our knowledge, there is no published study investigating the approach of dental practitioners to EPLs in the framework of the new classification. Also, there are very few surveys investigating the knowledge, attitudes, and awareness of dentists about management of EPLs [22,23]. Therefore, the aim of this study was to evaluate the attitude of Turkish dentists to various EPL cases through a questionnaire created according to the recent EPL classification. The null hypothesis was that there would be no consensus about the treatment approach of EPLs among dental practitioners.

Material and Methods

The ethical approval of this study was obtained from the Ethics Committee of Izmir Demokrasi University (No: 2021/08-04), and the study was conducted in compliance with the Helsinki Declaration of 2013.

Power Analysis

The sample size of the present study was determined basing on the data of a previous survey [24]. Using an appropriate power analysis program (G*Power 3.1.9.2), it was calculated that at least 286 participants were required for the study to have 80% power.

An online survey consisting of 3 parts and 27 questions was created using Google forms. The first part of the questionnaire included demographic parameters, the second part included the case-related questions, and the third part included questions regarding the general treatment approach to EPLs. For the second part of the survey, 3 different cases were created as grade 1, 2, and 3 of EPL, without root damage in patients with and without periodontitis, according to the new classification by Herrera et al [10]. Different periapical images were created by photoshopping (Adobe Photoshop, Adobe Inc, CA, USA) on a periapical radiograph, which had been taken from one of the authors (PMD) in 2020 (**Figures 1-3**). For each case, the participants were asked to assume that the EPL case belonged to individuals aged 40 years who did not smoke and had no systemic disease. Considering the cases, questions were focused on pulp vitality, antibiotic prescription, whether there was extensive periodontitis, and how the mobility status would affect the treatment plan. Treatment options in the survey were as follows: (1) RCT: cleaning and shaping of the root canals, intracanal medication, and hermetic filling of the root canals; (2) initial periodontal treatment (IPT): patient

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motivation and instruction, scaling, and root planning; (3) surgical periodontal treatment (SPT): flap reflection, removing granulation tissues and calculus from the root surface, placing bone graft material into the defect and placing barrier membrane; and (4) tooth extraction: removing the tooth from the socket in the alveolar bone.

Participants were asked how the treatment plan would be affected when there was extensive periodontitis, non-vital pulp, or mobility, and whether they would prescribe systemic antibiotics. Furthermore, regardless of the case questions, how the patient's age, presence of systemic disease, smoking, and the single- or multi-rooted tooth would affect the treatment plan were questioned. Finally, the participants were asked about the waiting period between RCT and IPT or SPT, and under which conditions they would apply a splint to the teeth with EPLs.

While all dentists who were currently practicing the profession, whether specialist or non-specialist, were included, those who were dentistry students and who were retired were not included in the study.

A pilot survey was tested among 20 dental practitioners including general dentists, endodontists, periodontists, and other dental specialists. Cronbach's alpha of the pilot study was 0.898. The results of the pilot study were not included in the main study.

The survey was sent through an online link via e-mail, WhatsApp, and social media platforms to a total of 1500 specialist dental practitioners and general dentists working in Turkey. The participants responded to the survey between February 1, 2023, and March 1, 2023. Before starting the survey, it was ensured that the voluntary consent of all participants was obtained. There is no conflict of interest in the present study.

Statistical Analysis

All data obtained from the questionnaire were analyzed using SSPS (version 21, IBM Corp, Armonk, NY, USA). Descriptive statistics, including means, standard deviations, and frequency distributions, were computed for each variable. This provided an overview of the central tendency and variability within the data. To assess the internal consistency of the questionnaire, a reliability analysis was conducted using Cronbach's alpha. Additionally, construct validity was assessed using factor analysis. The chi-square test statistic compared the critical value from the chi-square distribution with the degrees of freedom to determine statistical significance and was used for comparison of categorical variables. Bonferroni correction was used to adjust the significance level in the context of multiple comparisons to control the error rate. The upper limit for statistical significance was taken as $P<0.05$.

Results

Demographics of the Participants

Overall, 338 (22.5%) of the dentists to whom the survey was sent participated in the study. Of them, 152 (45%) were general dentists, 102 (30.2%) endodontists, 46 (13.6%) periodontists, and 38 (11.2%) were other specialists. With respect to sex, 217 (64.2%) participants were women, and 121 (35.8%) were men. Participants' ages ranged from 24 to 67 years (37.02±8.70); 98 (29%) had 1 to 5 years of professional experience, 54 (16%) had 6 to 10 years of experience, 91 (26.9%) had 11 to 15 years of experience, 35 (10.4%) had 16 to 20 years of experience, and 60 (17.8%) had more than 21 years of experience. Of the participants, 44 (13%) reported that they worked in a state hospital, Oral & Dental Health Center, 106 (31.4%) in a private hospital, 64 (18.9%) in a private office, 10 (3%) in a dental polyclinic, and 114 (33.7%) in a university hospital (**Table 2**).

Evaluation of Responses of All Participants, Regardless of Specialty, for Simulated Cases

Most dentists (63.6%) preferred IPT for case 1. Most dentists (65.1%) preferred to carry out IPT after RCT for non-vital teeth. For the teeth with horizontal mobility, 35.2% of participants preferred IPT. Even when the patient did not have generalized periodontitis, 50% of participants stated that only IPT would be enough. In the presence of diffuse extra-oral swelling, 41.7% preferred to prescribe antibiotics. Most answers for case 2 were similar to those of case 1 ($P>0.05$).

In case 3, for vital or non-vital teeth, the treatment plan was similar to that of case 1 and case 2. However, in case 3, teeth with horizontal mobility or both horizontal and vertical mobility, the majority of participants preferred tooth extraction ($P<0.05$). Without the diagnosis of generalized periodontitis, the mostly preferred treatment plan was "(first, IPT, second, RCT, and finally, SPT (21.9%). The preference of antibiotics prescription was similar to that in cases 1 and 2 ($P>0.05$).

Responses to General Treatment Approach to EPLs of All Dentists, Regardless of Specialty (%)

A more radical treatment approach was preferred by 31.1% dentists (n=105) in patients who smoked. In patients having systemic diseases that could impair healing outcomes, such as diabetes mellitus, most dentists (34.0%) preferred to follow the patient for a longer time. In elderly patients, most dentists (41.1%) preferred a more radical treatment approach. Most dentists (59.2%) stated that a single- or multi-rooted tooth with EPL would not change their treatment plan. However, 53% of dentists preferred to perform RCT and IPT simultaneously. Most

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Table 2. Demographic data, n (%).

Sex	
Female	217 (64.2)
Male	121 (35.8)
Age (mean±std. deviation)	37.02±8.70
Professional experience period	
1-5 years	98 (29.0)
6-10 years	54 (16.0)
11-15 years	91 (26.9)
16-20 years	35 (10.4)
>21 years	60 (17.8)
Specialty	
General dentist	152 (45.0)
Oral, dental, and maxillofacial surgery	8 (2.4)
Oral, dental, and maxillofacial radiology	8 (2.4)
Endodontics	102 (30.2)
Pediatric dentistry	10 (3.0)
Periodontology	46 (13.6)
Prosthetic dentistry	2 (0.6)
Restorative dentistry	10 (3.0)
Institution/organization	
State hospital/oral & dental health center	44 (13.0)
Private hospital/polyclinic	106 (31.4)
Private office	64 (18.9)
Dental polyclinic that i belong to/partner with	10 (3.0)
University hospital	114 (33.7)

Table 3. Responses to general treatment approach to endo-perio lesions of all dentists, regardless of specialty, n (%).

How does patient's smoking affect your treatment plan in teeth with endo-periodontal lesions? (n=338)	
My treatment plan does not change	102 (30.2)
I prefer a more radical treatment plan	119 (35.2)
I prefer a more conservative treatment plan	9 (2.7)
I prefer to follow up patients for a longer period of time	105 (31.1)
I decide the treatment plan according to the patient's attitude	3 (0.9)
How does the patient's having a systemic disease (eg, diabetes) that may impair the healing mechanism affect your treatment plan in teeth with EPLs? (n=338)	
My treatment plan does not change	48 (14.2)
I prefer a more radical treatment plan	113 (33.4)
I prefer a more conservative treatment plan	54 (16.0)
I prefer to follow up patients for a longer period of time	115 (34.0)
I decide the treatment plan according to the patient's attitude.	1 (0.3)
I prefer extraction	2 (0.6)
I consult the medical doctor and i decide the treatment plan according to whether the diabetes can be controlled or not	5 (1.5)

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Table 3 continued. Responses to general treatment approach to endo-perio lesions of all dentists, regardless of specialty, n (%).

How does advanced age affect your treatment plan in teeth with EPLs?		
My treatment plan would not change	90	(26.6)
I prefer a more radical treatment plan	139	(41.1)
I prefer a more conservative treatment plan	46	(13.6)
I follow up patients for a longer period of time	60	(17.8)
I decide the treatment plan according to the patient's systemic health	2	(0.6)
I prefer a radical treatment if it is foreseen that RCT will not be successful	1	(0.3)
How does the single or multi-rooted tooth affect your treatment plan in teeth with EPLs? (n=338)		
My treatment plan does not change	200	(59.2)
I prefer a more radical treatment plan for single rooted teeth	20	(5.9)
I prefer a more conservative treatment plan for single rooted teeth	33	(9.8)
I prefer a more radical treatment plan for multi-rooted teeth	66	(19.5)
I prefer a more conservative treatment plan for multi-rooted teeth	18	(5.3)
I evaluate the bone damage and configuration of the periodontal involvement completely	1	(0.3)
What is your waiting period between 2 treatments in cases with EPLs where RCT and PT should be performed? (n=332)		
I do not wait, i prefer to carry out the treatments simultaneously	179	(53.0)
2-3 days	1	(0.3)
1-2 weeks	8	(2.4)
3 weeks	110	(32.5)
3 months	26	(7.7)
6 months	6	(1.8)
When healing occurs in periodontal tissues	2	(0.6)
What is your follow-up period to decide whether to perform SPT after IPT, in cases with doubtful prognosis? (n=333)		
2 weeks	4	(1.2)
3 weeks	81	(24.0)
4-6 weeks	10	(3.0)
3 months	188	(55.6)
6 months	50	(14.8)
Under what conditions do you apply splint on teeth with EPLs? (n=338)		
I don't apply splint	73	(21.6)
If there is horizontal mobility	101	(29.9)
If there is horizontal and vertical mobility	159	(47.0)
I do it under any circumstance	4	(1.2)
If there is Mühlemann class II horizontal mobility	1	(0.3)

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Table 4. Responses to case 1 according to specialty, n (%).

	General dentists	Endodontics	Periodontists	*P*
Case 1: Which treatment plan would you prefer for the tooth #36? (n=300)				
RCT and follow-up	10 (6.6)	2 (2.0)	4 (8.7)	
IPT and follow-up	74 (48.7)	82 (80.4)	30 (65.2)	
1st RCT, 2nd IPT, and follow-up	22 (14.5)	6 (5.9)	2 (4.3)	
1st IPT, 2nd RCT, and follow-up	30 (19.7)	8 (7.8)	4 (8.7)	**0.000***
1st RCT, 2nd IPT, and finally SPT	2 (1.3)	0 (0.0)	0 (0.0)	
1st IPT, 2nd, RCT, and finally SPT	10 (6.6)	4 (3.9)	6 (13.0)	
Tooth extraction	4 (2.6)	0 (0.0)	0 (0.0)	
Which treatment plan would you prefer if the tooth was non-vital? (n=300)				
My treatment plan would not change	22 (14.5)	4 (3.9)	4 (8.7)	
RCT and follow-up	16 (10.5)	2 (2.0)	4 (8.7)	
IPT and follow-up	0 (0.0)	0 (0.0)	0 (0.0)	
1st RCT, 2nd IPT, and follow-up	82 (53.9)	86 (84.3)	34 (73.6)	**0.000***
1st IPT, 2nd RCT, and follow-up	28 (18.4)	8 (7.8)	2 (4.3)	
1st RCT, 2nd IPT, and finally SPT	16 (10.5)	6 (5.9)	4 (8.7)	
1st IPT, 2nd RCT, and finally SPT	6 (3.9)	0 (0.0)	2 (4.3)	
Tooth extraction	4 (2.6)	0 (0.0)	0 (0.0)	
Which treatment plan would you prefer if the tooth had horizontal mobility? (n=300)				
My treatment plan would not change	48 (31.8)	34 (33.3)	18 (40.0)	
RCT and follow-up	10 (6.6)	2 (2.0)	0 (0.0)	
IPT and follow-up	42 (27.8)	44 (43.1)	22 (48.9)	
1st RCT, 2nd IPT and follow-up	17 (11.3)	14 (13.7)	8 (17.8)	**0.001***
1st IPT, 2nd RCT and follow-up	27 (17.9)	14 (13.7)	8 (17.8)	
1st RCT, 2nd IPT and finally SPT	20 (13.2)	20 (19.6)	1 (2.2)	
1st IPT, 2nd RCT and finally SPT	18 (11.9)	10 (9.8)	4 (8.9)	
Tooth extraction	17 (11.3)	0 (0.0)	2 (4.4)	
Which treatment plan would you prefer if the patient did not have generalized periodontitis? (n=300)				
My treatment plan would not change	67 (44.1)	61 (60.4)	20 (43.5)	
RCT and follow-up	28 (18.4)	10 (9.9)	10 (21.7)	
IPT and follow-up	56 (36.8)	69 (68.3)	18 (39.1)	
1st RCT, 2nd IPT, and follow-up	20 (13.2)	12 (11.9)	6 (13.0)	
1st IPT, 2nd RCT, and follow-up	32 (21.1)	8 (7.9)	4 (8.7)	**0.000***
1st RCT, 2nd IPT, and finally SPT	8 (5.3)	2 (2.0)	2 (4.3)	
1st IPT, 2nd RCT, and finally SPT	4 (2.6)	0 (0.0)	6 (13.0)	
Tooth extraction	2 (1.3)	0 (0.0)	0 (0.0)	
I would check occlusion	2 (1.3)	0 (0.0)	0 (0.0)	

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Table 4 continued. Responses to case 1 according to specialty, n (%).

	General dentists	Endodontics	Periodontists	*P*
Under what conditions would you prescribe systemic antibiotics to the patient? (n=300)				
I would not prescribe antibiotics	32 (21.1)	42 (41.2)	10 (21.7)	
If there was diffuse intra-oral swelling	29 (19.1)	10 (9.8)	8 (17.4)	
If there was diffuse extra-oral swelling	55 (36.2)	48 (47.1)	22 (47.8)	
If the infection was fistulized	4 (2.6)	0 (0.0)	0 (0.0)	**0.000***
If the tooth was non-vital	4 (2.6)	0 (0.0)	2 (4.3)	
I would prescribe antibiotics under all circumstances	28 (18.4)	0 (0.0)	0 (0.0)	
If there was a systemic finding	0 (0.0)	2 (2.0)	4 (8.7)	

* p<0.05, chi-square test.

participants (55.6%) preferred to wait 3 months after completion of IPT for the decision of SPT. Application of splints was chosen by 47% of dentists if the tooth had both horizontal and vertical mobility (**Table 3**).

Responses to Simulated Cases of General Dentists, Endodontists, and Periodontists

Case 1

There were significant differences in responses to the variations regarding whether the tooth was non-vital, there was mobility, or the patient had generalized periodontitis in case 1. In the first question, endodontists and general dentists chose the option "IPT and follow-up" most frequently (*P*<0.05). In non-vital teeth, general dentists, endodontists, and periodontists selected the option "first, RCT, second, IPT, and follow-up" (*P*<0.05). However, 18.4% of general dentists chose the option "first, IPT, second, RCT, and follow-up" even in non-vital teeth (*P*<0.05). In teeth with horizontal mobility, general dentists (31.8%), endodontists (33.3%), and periodontists (40%) considered applying the same treatment plan they had previously chosen. Treatment choice of "IPT and follow-up" was chosen significantly less often by general dentists (27.8%), when compared with endodontists (43.1%) and periodontists (48.9%; *P*<0.05). "First, RCT, second, IPT, and finally, SPT" was selected significantly more by general dentists (13.2%) and endodontists (19.6%; *P*<0.05). Likewise, in patients not having generalized periodontitis, general dentists, endodontists, and periodontists preferred the treatment option "IPT and follow-up". Most endodontists (47.1%) and periodontists (47.8%) preferred to prescribe antibiotics if there was diffuse extra-oral swelling (*P*<0.05). The option "I would prescribe antibiotics under all circumstances" was chosen by 18% of general dentists (*P*<0.05; **Table 4**).

Case 2

There were significant differences in the chosen treatment plans of the cases with different variations in case 2. In the first question, general dentists, endodontists, and periodontists chose the option "IPT and follow-up" significantly more frequently than the other options (*P*<0.05). In non-vital teeth, all 3 groups of dentists preferred "first, RCT, second, IPT, and follow-up" option significantly more than the other options. Eleven percent of general dentists selected tooth extraction (*P*<0.05). In teeth with horizontal mobility, all groups stated that they would not change the treatment plan. The "IPT and follow-up" option was selected significantly less often by periodontists than by the other groups (*P*<0.05). In patients not having generalized periodontitis, endodontists and general dentists mostly preferred the option "IPT and follow-up" (*P*<0.05). "First, RCT, second, IPT, and finally, SPT" and "first, IPT, second, RCT, and finally, SPT" treatment options were chosen significantly more frequently by periodontists (*P*<0.05). Antibiotic prescription was not chosen by 37.3% of endodontists; 18.4% of general dentists indicated they would prescribe antibiotics in all situations, and most periodontists (56.5%) answered that they would prescribe antibiotics if there was diffuse extra-oral swelling (**Table 5**). The differences between the groups were significant (*P*<0.05).

Case 3

In the different variations of case 3, there were significant differences among the treatment plans chosen by the 3 groups of dentists. In the first question, most endodontists (31.4%) and periodontists (30.4%) chose the option "IPT and follow-up" significantly more frequently (*P*<0.05), and most general dentists (32.9%) preferred tooth extraction (*P*<0.05). In non-vital teeth, periodontists (30.4%) and endodontists (39.2%) more frequently chose the option "first, RCT, second, IPT, and follow-up" than general dentists (23%; *P*<0.05). Most general

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Table 5. Responses to case 2 according to specialty, n (%).

	General dentists	Endodontists	Periodontists	*p*
Case 2: Which treatment plan would you prefer for the tooth #36? (n=300)				
RCT and follow-up	4 (2.6)	0 (0.0)	4 (4.3)	
IPT and follow-up	58 (38.2)	72 (70.6)	14 (30.4)	
1st RCT, 2nd IPT, and follow-up	11 (7.2)	12 (11.8)	6 (13.0)	
1st IPT, 2nd RCT, and follow-up	30 (19.7)	6 (5.6)	6 (13.0)	**0.000***
1st RCT, 2nd IPT, and finally SPT	14 (9.2)	4 (3.9)	6 (13.0)	
1st IPT, 2nd RCT, and finally SPT	28 (18.4)	8 (7.8)	10 (21.7)	
Tooth extraction	7 (4.6)	0 (0.0)	2 (4.3)	
Which treatment plan would you prefer if the tooth was non-vital? (n=300)				
My treatment plan would not change	40 (26.3)	18 (17.6)	14 (30.4)	
RCT and follow-up	6 (3.9)	2 (2.0)	2 (4.3)	
IPT and follow-up	4 (2.6)	4 (3.9)	0 (0.0)	
1st RCT, 2nd IPT, and follow-up	57 (37.5)	64 (62.7)	18 (39.1)	
1st IPT, 2nd RCT, and follow-up	30 (19.7)	10 (9.8)	4 (8.7)	**0.002***
1st RCT, 2nd IPT, and finally SPT	30 (19.7)	18 (17.6)	14 (30.4)	
1st IPT, 2nd RCT, and finally SPT	14 (9.2)	4 (3.9)	6 (13.0)	
Tooth extraction	11 (7.2)	0 (0.0)	2 (4.3)	
Which treatment plan would you prefer if the tooth had horizontal mobility? (n=300)				
My treatment plan would not change	62 (40.8)	44 (43.1)	26 (56.5)	
RCT and follow-up	4 (2.6)	0 (0.0)	0 (0.0)	
IPT and follow-up	34 (22.4)	38 (37.3)	6 (13.0)	
1st RCT, 2nd IPT, and follow-up	16 (10.5)	16 (15.7)	8 (17.4)	
1st IPT, 2nd RCT, and follow-up	19 (12.5)	8 (7.8)	6 (13.0)	
1st RCT, 2nd IPT, and finally SPT	32 (21.1)	26 (25.5)	4 (8.7)	**0.000***
1st IPT, 2nd RCT, and finally SPT	22 (14.5)	14 (13.7)	16 (34.8)	
Tooth extraction	25 (16.4)	0 (0.0)	4 (8.7)	
Occlusal adjustment	0 (0.0)	0 (0.0)	1 (2.2)	
RCT and occlusal adjustment	0 (0.0)	0 (0.0)	1 (2.2)	

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Table 5 continued. Responses to case 2 according to specialty, n (%).

	General dentists	Endodontists	Periodontists	*p*
Which treatment plan would you prefer if the patient did not have generalized periodontitis? (n=300)				
My treatment plan would not change	75 (49.3)	62 (60.8)	26 (56.5)	
RCT and follow-up	16 (10.5)	2 (2.0)	4 (8.7)	
IPT and follow-up	52 (34.2)	54 (52.9)	6 (13.0)	
1st RCT, 2nd IPT, and follow-up	15 (9.9)	20 (19.6)	6 (13.0)	
1st IPT, 2nd RCT, and follow-up	25 (16.4)	8 (7.8)	6 (13.0)	**0.000***
1st RCT, 2nd IPT, and 3rd SPT	14 (9.2)	8 (7.8)	10 (21.7)	
1st IPT, 2nd RCT, and 3rd SPT	23 (15.1)	10 (9.8)	12 (26.1)	
Tooth extraction	5 (3.3)	0 (0.0)	2 (4.3)	
Occlusal adjustment	2 (1.3)	0 (0.0)	0 (0.0)	
Under what conditions would you prescribe systemic antibiotics to the patient? (n=300)				
I would not prescribe antibiotics	34 (22.4)	38 (37.3)	4 (8.7)	
If there was diffuse intra-oral swelling	27 (17.8)	10 (9.8)	8 (17.4)	
If there was diffuse extra-oral swelling	58 (38.2)	50 (49.0)	26 (56.5)	
If the infection was fistulized	2 (1.3)	0 (0.0)	0 (0.0)	**0.000***
If the tooth were non-vital	3 (2.0)	2 (2.0)	2 (4.3)	
I would prescribe antibiotics under all circumstances	28 (18.4)	0 (0.0)	2 (4.3)	
If there was a systemic finding	0 (0.0)	2 (2.0)	4 (8.7)	

* p<0.05, chi-square test.

dentists (37.5%) preferred tooth extraction (*P*<0.05). In teeth with horizontal mobility, all groups chose the same treatment as they chose in the preceding question. The option of "IPT and follow-up" was significantly more frequently chosen by endodontists (21.6%) among the 3 groups (*P*<0.05). Most general dentists preferred extraction (*P*<0.05). In teeth with horizontal and vertical mobility, extraction was the most preferred option in all groups, with the highest preference rate (75.7%) by general dentists (*P*<0.05). In patients not having generalized periodontitis, endodontists and general dentists preferred the options "IPT and follow-up" and "first, IPT, second, RCT, and finally, SPT" most frequently (*P*<0.05). "First, RCT, second, IPT, and finally, SPT" treatment option was chosen significantly more frequently by periodontists (*P*<0.05). In all groups, most participants chose the option "I would prescribe antibiotics if there was diffuse extra-oral swelling". While 35.3% of endodontists did not prefer prescribing antibiotics (*P*<0.05), 30.3% of general dentists preferred antibiotics in all variations of case 3 (*P*<0.05; **Table 6**).

Responses to General Treatment Approach to EPLs of General Dentists, Endodontists, and Periodontists

For patients who smoked, general dentists and endodontists preferred a more radical treatment plan than did periodontists (*P*<0.05). Most periodontists (39.1%) chose to follow patients for a longer period (*P*<0.05). In patients with systemic diseases, such as diabetes, general dentists preferred a more radical treatment plan than did the other groups (*P*<0.05). Most endodontists (47.1%) chose to follow patients for a longer period in case of systemic diseases (*P*<0.05). Most from all 3 groups chose the option "I prefer a more radical treatment plan" for elderly patients (*P*<0.05), while they stated that their treatment plan would not change if the tooth was single- or multi-rooted. When comparing the answers given to waiting time between RCT and PT, no significant difference was found among the 3 groups (*P*>0.05). While most dentists in the 3 groups preferred to apply both treatments simultaneously, some dentists preferred waiting 3 weeks in between treatments (*P*>0.05). General dentists (51.7%), endodontists (62.7%), and periodontists (60.9%) mostly preferred to wait

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Table 6. Responses to case 3 according to specialty, n (%).

	General dentists	Endodontists	Periodontists	*p*
Case 3: Which treatment plan would you prefer for tooth #36? (n=300)				
RCT and follow-up	0 (0.0)	2 (2.0)	0 (0.0)	**0.000***
IPT and follow-up	22 (14.5)	32 (31.4)	14 (30.4)	
1st RCT, 2nd IPT, and follow-up	15 (9.9)	10 (9.8)	2 (4.3)	
1st IPT, 2nd RCT, and follow-up	18 (11.8)	12 (11.8)	4 (8.7)	
1st RCT, 2nd IPT, and finally SPT	20 (13.2)	20 (19.6)	8 (17.4)	
1st IPT, 2nd RCT, and finally SPT	24 (15.8)	20 (19.6)	10 (21.7)	
Tooth extraction	50 (32.9)	6 (5.9)	5 (10.9)	
1st IPT, 2nd SPT	2 (1.3)	0 (0.0)	2 (4.3)	
Only SPT	0 (0.0)	0 (0.0)	1 (2.2)	
I would talk to the patient and determine the treatment plan accordingly	1 (0.7)	0 (0.0)	0 (0.0)	
Which treatment plan would you prefer if the tooth was non-vital? (n=300)				
My treatment plan would not change	30 (19.7)	30 (29.4)	16 (34.8)	**0.000***
RCT and follow-up	2 (1.3)	0 (0.0)	0 (0.0)	
IPT and follow-up	0 (0.0)	0 (0.0)	0 (0.0)	
1st RCT, 2nd IPT, and follow-up	35 (23.0)	40 (39.2)	14 (30.4)	
1st IPT, 2nd RCT, and follow-up	0 (0.0)	0 (0.0)	0 (0.0)	
1st RCT, 2nd IPT, and finally SPT	6 (3.9)	8 (7.8)	4 (8.7)	
1st IPT, 2nd RCT, and finally SPT	18 (11.8)	12 (11.8)	6 (13.0)	
Tooth extraction	57 (37.5)	8 (7.8)	4 (8.7)	
Which treatment plan would you prefer if the tooth had horizontal mobility? (n=300)				
My treatment plan would not change	47 (30.9)	52 (51.0)	24 (52.2)	**0.000***
RCT and follow-up	0 (0.0)	0 (0.0)	0 (0.0)	
IPT and follow-up	11 (7.2)	22 (21.6)	4 (8.7)	
1st RCT, 2nd IPT, and follow-up	15 (9.9)	10 (9.8)	4 (8.7)	
1st IPT, 2nd RCT, and follow-up	4 (2.6)	10 (9.8)	10 (21.7)	
1st RCT, 2nd IPT, and finally SPT	24 (15.8)	28 (27.5)	8 (17.4)	
1st IPT, 2nd RCT, and finally SPT	22 (14.5)	22 (21.6)	10 (21.7)	
Tooth extraction	74 (48.7)	10 (9.8)	6 (13.0)	
I would decide due to mobility level	0 (0.0)	0 (0.0)	2 (4.3)	
Occlusal adjustment and flap surgery	0 (0.0)	0 (0.0)	2 (4.3)	
1st IPT, 2nd SPT	2 (1.3)	0 (0.0)	0 (0.0)	

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Table 6 continued. Responses to case 3 according to specialty, n (%).

	General dentists	Endodontists	Periodontists	*p*
Which treatment plan would you prefer if the tooth had both horizontal and vertical mobility? (n=300)				
My treatment plan would not change	26 (17.1)	22 (21.6)	6 (13.0)	**0.000***
RCT and follow-up	2 (1.3)	0 (0.0)	0 (0.0)	
IPT and follow-up	6 (3.9)	2 (2.0)	0 (0.0)	
1st RCT, 2nd IPT, and follow-up	4 (2.6)	6 (5.9)	6 (13.0)	
1st IPT, 2nd RCT, and follow-up	6 (3.9)	2 (2.0)	4 (8.7)	
1st RCT, 2nd IPT, and finally SPT	12 (7.9)	26 (25.5)	4 (8.7)	
1st IPT, 2nd RCT, and finally SPT	6 (3.9)	20 (19.6)	2 (4.3)	
Tooth extraction	115 (75.7)	46 (45.1)	26 (56.5)	
Hemisection	0 (0.0)	0 (0.0)	4 (8.7)	
I would decide according to the patient	1 (0.7)	0 (0.0)	0 (0.0)	
Which treatment plan would you prefer if the patient did not have generalized periodontitis? (n=300)				
My treatment plan would not change	48 (31.6)	58 (56.9)	24 (52.2)	**0.000***
RCT and follow-up	6 (3.6)	2 (2.0)	2 (4.3)	
IPT and follow-up	20 (13.2)	18 (17.6)	10 (21.7)	
1st RCT, 2nd IPT, and follow-up	13 (8.6)	14 (13.7)	4 (8.7)	
1st ipt, 2nd RCT, and follow-up	8 (5.3)	14 (13.7)	2 (4.3)	
1st RCT, 2nd IPT, and finally SPT	20 (13.2)	24 (23.5)	16 (34.8)	
1st IPT, 2nd RCT, and finally SPT	36 (23.7)	22 (21.6)	6 (13.0)	
Tooth extraction	47 (30.9)	8 (7.8)	5 (10.9)	
1st IPT, 2nd SPT	2 (1.3)	0 (0.0)	0 (0.0)	
Only SPT	0 (0.0)	0 (0.0)	1 (2.2)	
Under what conditions would you prescribe systemic antibiotics to the patient? (n=330)				
I would not prescribe antibiotics	32 (21.1)	36 (35.3)	4 (8.7)	**0.000***
If there was diffuse intra-oral swelling	16 (10.5)	6 (5.9)	6 (13.0)	
If there was diffuse extra-oral swelling	54 (35.5)	54 (52.9)	26 (56.5)	
If the infection was fistulized	2 (1.3)	0 (0.0)	0 (0.0)	
If the tooth was non-vital	2 (1.3)	0 (0.0)	2 (4.3)	
I would prescribe antibiotics under all circumstances	46 (30.3)	4 (3.9)	4 (8.7)	
If there was a systemic finding	0 (0.0)	2 (2.0)	4 (8.7)	

* p<0.05, chi-square test

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Table 7. Responses to general treatment approaches to endo-perio lesions according to specialty.

	General dentists	Endodontists	Periodontists	*p*
How does patient's smoking affect your treatment plan in teeth with EPLs? (n=300)				
My treatment plan does not change	44 (28.6)	36 (35.3)	14 (30.4)	
I prefer a more radical treatment plan	53 (34.9)	34 (33.3)	7 (15.2)	
I prefer a more conservative treatment plan	4 (2.6)	0 (0.0)	5 (10.9)	**0.002***
I prefer to follow up patients for a longer period of time	50 (32.9)	32 (31.4)	18 (39.1)	
I decide the treatment plan according to the patient's attitude	1 (0.7)	0 (0.0)	2 (4.3)	
How does the patient's having a systemic disease (eg, diabetes) that may impair the healing mechanism affect your treatment plan in teeth with EPLs? (n=300)				
My treatment plan does not change	22 (14.5)	16 (15.7)	6 (13.0)	
I prefer a more radical treatment plan	62 (40.8)	23 (22.5)	11 (23.9)	
I prefer a more conservative treatment plan	20 (13.2)	15 (14.7)	9 (19.6)	
I prefer to follow up patients for a longer period of time	46 (30.3)	48 (47.1)	14 (30.4)	**0.000***
I decide the treatment plan according to the patient's attitude	0 (0.0)	0 (0.0)	1 (2.2)	
I prefer extraction	2 (1.3)	0 (0.0)	0 (0.0)	
I consult the medical doctor and i decide the treatment plan according to whether the diabetes can be controlled or not	0 (0.0)	0 (0.0)	5 (10.9)	
How does advanced age affect your treatment plan in teeth with EPLs? (n=300)				
My treatment plan would not change	33 (21.7)	30 (29.4)	15 (32.6)	
I prefer a more radical treatment plan	71 (46.7)	36 (35.3)	18 (39.1)	
I prefer a more conservative treatment plan	24 (15.8)	22 (21.6)	6 (13.0)	
I follow up patients for a longer period of time	24 (15.8)	14 (13.7)	4 (8.7)	**0.008***
I decide the treatment plan according to the patient's systemic health	0 (0.0)	0 (0.0)	2 (4.3)	
I prefer a radical treatment if it is foreseen that rct will not be successful	0 (0.0)	0 (0.0)	1 (2.2)	
How does the single or multi-rooted tooth affect your treatment plan in teeth with EPLs? (n=300)				
My treatment plan does not change	90 (59.2)	62 (60.8)	27 (58.7)	
I prefer a more radical treatment plan for single rooted teeth	6 (3.9)	10 (9.8)	4 (8.7)	
I prefer a more conservative treatment plan for single rooted teeth	16 (10.5)	10 (9.8)	0 (0.0)	
I prefer a more radical treatment plan for multi-rooted teeth	26 (17.1)	20 (19.6)	10 (21.7)	**0.009***
I prefer a more conservative treatment plan for multi-rooted teeth	14 (9.2)	0 (0.0)	4 (8.7)	
I evaluate the bone damage and configuration of the periodontal involvement completely.	0 (0.0)	0 (0.0)	1 (2.2)	

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Table 7 continued. Responses to general treatment approaches to endo-perio lesions according to specialty.

	General dentists	Endodontists	Periodontists	*p*
What is your waiting period between 2 treatments in cases with EPLs where RCT and PT should be performed? (n=300)				
I do not wait, i prefer to carry out the treatments simultaneously	70 (47.6)	68 (66.7)	28 (60.9)	0.073
2-3 days	0 (0.0)	0 (0.0)	0 (0.0)	
1-2 weeks	4 (2.7)	4 (3.9)	0 (0.0)	
3 weeks	55 (37.4)	24 (23.5)	12 (26.1)	
3 months	12 (8.2)	4 (3.9)	6 (13.0)	
6 months	4 (2.7)	2 (2.0)	0 (0.0)	
When healing occurs in periodontal tissues	2 (1.4)	0 (0.0)	0 (0.0)	
What is your follow-up period to decide whether to perform SPT after IPT, in cases with doubtful prognosis? (n=300)				
2 weeks	0 (0.0)	0 (0.0)	2 (4.3)	**0.000***
3 weeks	49 (33.3)	10 (9.8)	8 (17.4)	
4-6 weeks	4 (2.7)	0 (0.0)	6 (13.0)	
3 months	76 (51.7)	64 (62.7)	28 (60.9)	
6 months	18 (12.2)	26 (25.5)	2 (4.3)	
Under what conditions do you apply splint on teeth with EPLs? (n=300)				
I do not apply splint	39 (25.7)	24 (23.5)	4 (8.7)	**0.000***
If there is horizontal mobility	39 (25.7)	24 (23.5)	28 (60.9)	
If there is horizontal and vertical mobility	70 (46.1)	54 (52.9)	13 (28.3)	
I apply, under all circumstances	4 (2.6)	0 (0.0)	0 (0.0)	
If there is Mühlemann class II horizontal mobility	0 (0.0)	0 (0.0)	1 (2.2)	

* p<0.05, chi-square test.

for 3 months for SPT decision after completion of IPT in cases with doubtful prognosis (*P*<0.05). Most periodontists (60.9%) preferred to apply a splint in the presence of horizontal mobility (*P*<0.05). General dentists (46.1%) and endodontists (52.9%) most often chose to apply a splint in the presence of horizontal and vertical mobility (*P*<0.05; **Table 7**).

Discussion

EPLs are among the most challenging cases for dental care providers. Combined EPLs are responsible for more than 50% of general tooth loss [25]. It has been reported that the treatment approach can differ significantly, especially in terms of the treatment sequence and the waiting time between multidisciplinary treatment steps. The aim of the present survey was to investigate the treatment approaches of dentists with case simulations, according to the new classification of EPL. In this new classification, EPLs are divided into 2 main categories: with and without root damage [21]. In the present study, questions were created on cases of EPL without root damage. EPL with root damage is likely to have a wider range of variations that would make it more difficult to question the treatment plan. Limiting the cases of EPL without root damage made the survey simpler and enabled comparison of various treatment preferences.

True combined EPL cases are more frequently seen in molar teeth than in non-molar teeth [26]. Therefore, cases of molar teeth were simulated in the present study. In the present survey, questions were asked about different versions of the 3 cases. For each case presented in the photograph, only 1 variable was changed; participants were to assume that the other variables were the same, and the questions were generated accordingly. In case 3, even though the probability of the tooth being vital was rather low, as the lesion was large

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and the periodontal damage was huge, an option was added in which the vitality test of the case was positive, considering the conditions of partial necrosis.

Since the participants with specialties other than endodontists, periodontists, and general dentists did not reach a statistically sufficient number, comparisons were made only among endodontists, periodontists, and general dentists. The answers of other dental specialists were included in the statistical analyses when analyzing "all dentists". According to the present findings, endodontists and periodontists were not in agreement when compared with general dentists. In fact, the number of questions for which the 3 groups preferred the same treatment option was higher than that of the endodontists and periodontists. Considering that the treatment of EPL cases should be multidisciplinary, it is remarkable that endodontists and periodontists often preferred different approaches. Therefore, according to the present findings, the null hypothesis was accepted.

Few studies have evaluated the physician's approach to EPLs, and they particularly examined the knowledge and awareness of practitioners. In our study, the approach to different cases and situations was evaluated, rather than solely the awareness of dentists. Therefore, it is not possible to directly compare the results of our findings with those of the other studies. Khandelwal et al [23], in a survey study, reported that many dentists considered EPLs problematic and generally refer patients with teeth with EPLs to specialists instead of handling the cases themselves. They also reported that the dental practitioners, except periodontists and endodontists, lacked experienced. Also, Çirakoglu and Karayurek stated that the awareness of endodontists and periodontists of EPLs is higher than that of other specialists and general dentists [22]. Consistent with the results of the above researchers, our findings showed that general dentists preferred tooth extraction at a much higher rate than did periodontists and endodontists, especially in different variations of case 3, which was a case of the new EPL classification grade 3. Therefore, it can be considered that general dentists are not sufficiently competent to treat these lesions or evaluate treatment options, compared with the other specialists mentioned. When viewed from another perspective, it can be interpreted that there is a consensus among general dentists in the approach of such cases, and that such teeth are seen as hopeless by them.

It has been reported that when pulp responses are negative to vitality tests, RCT should be the first treatment step in EPLs [17,27]. Accordingly, most dentists in our study (65%) stated that they would first perform RCT in EPL cases with non-vital pulp. Some studies advocate that PT should be considered after a waiting period, because RCT also contributes to periodontal tissue healing [27]. Different time intervals have been suggested between RCT and IPT, including 2 to 3 months, 4, and 6 months [16,20,28]. However, Gupta et al found, that in EPLs, the observation period for IPT may not be needed, and there was no negative effect of non-surgical PT simultaneously performed with RCT on the healing of periodontal tissues [29]. Similarly, in the present study, 53% of participants reported that they would perform RCT and PT simultaneously. Another aspect to be considered is the follow-up period for an indication of SPT. According to the results of the present study, most dentists declared they would prefer a 3-month follow-up period.

According to the findings of the present study, interestingly, most dentists stated that their treatment plan would not change in single- or multi-rooted tooth with EPLs. However, the prognosis of molar teeth was reported to be better than that of non-molar teeth in cases of EPL, because of alternative treatment options of molar teeth, such as hemisection or root amputation [30].

Another issue that needs to be discussed is the prescribing of antibiotics in EPL cases. In the present study, while most endodontists answered that they would prefer to not prescribe antibiotics in EPL cases, most general dentists reported that they would prescribe antibiotics in every EPL case. Most periodontists have reported that they would prescribe antibiotics only if there was a diffuse extra-oral swelling. These results, with less prescribing of antibiotics by endodontists and periodontists, may indicate that they manage EPL cases better than do general dentists. As a matter of fact, general dentists chose "extraction" as an answer much more frequently than did the other 2 groups of dentists. Although the prognosis of EPLs is difficult to predict, it is important to consider all alternative treatment options and to not decide for immediate extraction of the teeth [8].

Although our online survey was delivered to 1500 dentists, relatively few (338) participated. We think this may be explained by the comparatively long time needed to complete the survey, and the participants may have been confused about the case questions and therefore did not complete them all. These points can also be considered as limitations of this study. Our results should be supported by future cross-sectional studies with larger numbers of participants and in which potential points of confusion are eliminated.

According to the results of this study, endodontists, periodontists, and general dentists generally did not agree on the treatment approaches of EPL cases. In particular, the time interval and priority between endodontic and periodontal treatments, antibiotic prescription, treatment approach in smoking patients, and splinting in EPL cases are the points that need to be clarified. Our findings shed light on the deficiency in this issue and emphasize the need for clinical trials and evidence-based research to reach a consensus. Furthermore, reaching a consensus on the management of teeth with EPLs will allow for better systematic and successful treatment of such cases.

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Conclusions

We conclude that general dentists, endodontists, and periodontists generally follow different approaches in the treatment of EPLs. For instance, general dentists preferred tooth extraction more often than did endodontists and periodontists, especially in grade 3 EPLs. They also preferred to prescribe antibiotics more often in such cases than did the other specialists. However, the treatment approaches most preferred by all 3 groups of dentists were as follows:

- A more radical treatment plan if the patient smoked or had older age;
- Performing RCT and IPT simultaneously, when both treatments were required;
- Waiting 3 months between treatments to decide the indication for SPT;
- Not changing the treatment plan according to the tooth being single- or multi-rooted.

In summary, this study highlights the diverse treatment preferences among general dentists, endodontists, and periodontists when managing EPLs. These variations underscore the importance of interdisciplinary collaboration and continuing education to ensure comprehensive and evidence-based management of such cases. Further research and discussions within the dental community are warranted to establish consensus guidelines for the most appropriate management of EPLs.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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