

# Evaluation of PhD Students' and Endodontists' Treatment Approaches during the COVID-19 Pandemic: A Questionnaire-Based Survey

Keziban Olcay<sup>1,2</sup>  Selen I. Yusufoglu<sup>3</sup>

<sup>1</sup>Department of Endodontics, Faculty of Dentistry, Istanbul University-Cerrahpaşa, Istanbul, Turkey

<sup>2</sup>Department of Endodontics, Faculty of Dentistry, Istanbul Medipol University, Istanbul, Turkey

<sup>3</sup>Department of Endodontics, Faculty of Dentistry, Ankara Yıldırım Beyazıt University, Ankara, Turkey

**Address for correspondence** Keziban Olcay, DDS, PhD, Kocamustafapaşa Cd. No:34/E Postal Code:34098 34/E, Department of Endodontics, Faculty of Dentistry, Istanbul University-Cerrahpaşa, Cerrahpaşa, Fatih, Istanbul (e-mail: kolcay@istanbul.edu.tr).

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## Abstract

**Objectives** This study aimed to evaluate endodontists' treatment approaches during the novel coronavirus disease (COVID-19) pandemic.

**Materials and Methods** Web-based 16-question survey was sent to members of the Turkish Endodontic Society via social media and email between May 5 to 25, 2020, to obtain information about the members' demographic characteristics and treatment approaches of seven cases considering COVID-19. The cases represented different endodontic diseases such as symptomatic apical periodontitis, chronic apical periodontitis, acute apical abscess, asymptomatic and symptomatic cases required retreatment, third molar tooth with endodontic symptoms, and symptomatic irreversible pulpitis.

**Statistical Analysis** Statistical analysis was performed using a Chi-square test. The statistical significance was set at  $\alpha = 0.05$ .

**Results** Of the 203 respondents, 65.5% were females and 34.5% were males, 62.6% were endodontists and 37.4% were PhD students, 68% worked at a university, 21.2% worked at private clinics, and 10.8% worked at public clinics. Frequency of going to work was mostly once a week (31%). Most commonly performed treatments were “acute apical abscess (32.2%)” and “symptomatic irreversible pulpitis (30.8%).” The respondents most frequently preferred “to prescribe antibiotics and/or painkillers and postpone the treatment” in cases 1 and 6, “to follow-up” in cases 2 and 5, “to extract the tooth” in case 4, and “to start endodontic treatment but postpone the treatment by placing antibacterial medicament into the root canals” in cases 3 and 7 ( $p < 0.05$ ).

**Conclusion** During a pandemic, the general treatment approach for endodontic emergencies should be to eliminate acute symptoms and minimize the risk of transmission.

## Keywords

- ▶ coronavirus
- ▶ COVID-19
- ▶ endodontics
- ▶ pandemic
- ▶ survey

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## Introduction

On December 31, 2019, the World Health Organization (WHO) reported that cases of pneumonia of unknown etiology<sup>1</sup> occurred in the city of Wuhan, in the province of Hubei, China.<sup>2</sup> The cause of these cases was found to be a new coronavirus (2019-nCoV), which had not been previously detected in humans and the disease was named as the new coronavirus disease (COVID-19), but it was later renamed as severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2).<sup>3</sup>

The virus is transmitted from person to person mainly through close contact and droplets that infected individuals scatter into the environment through speech, coughing, and sneezing.<sup>3</sup> The agent is also transmitted to the oral, nasal, and eye mucosa by hand contact with surfaces contaminated with these droplets.<sup>4</sup> The presence of COVID-19 has been detected in the saliva of infected patients<sup>5</sup> and can be transmitted directly or indirectly with saliva.<sup>6</sup> Moreover, many live virus particles have been identified on the epithelial surface of the oral mucosa and on the dorsum of tongue of the SARS-CoV-2-positive patient.<sup>7</sup>

Angiotensin-converting enzyme II (ACE2) is the main host cell receptor of the virus. ACE2 receptors are abundant in oral mucosal tissues, salivary glands, and especially in epithelial cells of the tongue which are considered a potential high risk for the SARS-CoV-2 infection.<sup>7</sup> ACE2 has also been found on the tongue and mouth.<sup>7</sup> These receptors are considered to play a target role in the binding of 2019-nCoV and increase susceptibility to infection in individuals.<sup>6</sup> Additionally, dental professionals are likely to transmit 2019-nCoV due to prolonged face-to-face contact with the patient<sup>4</sup> and aerosols formed during dental procedures.<sup>8</sup> Besides, the incubation period of SARS-CoV-2 disease is 5 to 6 days on average, and in some cases, symptoms of the disease are observed after 14 days,<sup>4</sup> but this period can be extend up to 24 days.<sup>9,10</sup> As many people experience only mild symptoms of the disease<sup>11</sup> and individuals who have no symptoms can easily transmit the disease,<sup>12</sup> dental professionals are highly likely to encounter 2019-nCoV and spread the disease.

Among dental professionals, endodontists are highly likely to encounter patients with suspected or diagnosed SARS-CoV-2 infection<sup>10</sup> because (1) endodontists are the first contact for patients with odontogenic pain and/or swelling, (2) endodontic emergencies receive the majority of dental emergency applications<sup>13</sup> during the COVID-19 pandemic,<sup>14</sup> and (3) endodontic treatment is time consuming and thus requires long-term close contact with the patient. The use of air-water sprays and high-speed tools during treatment also causes a considerable amount of aerosol formation.<sup>15</sup> Since 2019-nCoV can live for at least 3 hours in aerosols and days on surfaces,<sup>16</sup> SARS-CoV-2 is likely to be transmitted by aerosol transmission. Therefore, endodontic specialists could increase the risk of spreading the infection.

Emergency treatments in endodontics describe conditions that are caused by infection or inflammation of the pulpal and/or periapical tissues, often with severe pain or swelling,

and require urgent diagnosis and treatment. These are problematic situations that create some special difficulties for both the specialist and the patient in diagnosis and treatment approach. Endodontists employed different treatment approaches for patients who applied for emergency treatment in endodontics during the pandemic period. Therefore, this questionnaire-based survey identifies the treatment approaches used and contributes to a consensus on the endodontic treatment procedures and the patient management protocol to apply during the COVID-19 pandemic.

## Materials and Methods

Ethical approval of the study design was obtained from the Institutional Review Board of Istanbul Medipol University (Approval Number:10840098-604.01.01-E.14696/326) and Ministry of Health of Turkey. Verbal consent was obtained from the patients whose radiographs were used for reference in the study. In this survey, the participants were only given information about the patients in accordance with the clinical scenarios and radiographs provided for reference. Only the principal researcher had access to the data. Participation in the study was voluntary, and the questionnaires were anonymous to ensure the privacy of all information obtained from the study.

### Sample Size Calculation

There are totally 704 PhD students and endodontists in endodontic departments registered with the Turkish Endodontics Association. Therefore the population size of the study group was 704. The confidence level of the research was calculated as 95% and confidence interval (margin of error) was 5.81 with the power analysis. The sample size was calculated as 203 participants, representing 90% power. When the number of participants reached 203, the survey was completed.

### Design of the Survey and Data Collection

An online 16-question survey (available at: [https://docs.google.com/forms/d/e/1FAIpQLScW4E87E1yaDvN54ec3zA\\_KkqUjBu0zawCHclO0ypooz\\_8h2w/viewform?usp=pp\\_url](https://docs.google.com/forms/d/e/1FAIpQLScW4E87E1yaDvN54ec3zA_KkqUjBu0zawCHclO0ypooz_8h2w/viewform?usp=pp_url)) and a brief cover letter describing the study was formulated using Google forms. The survey data were collected during a 3-week period from May 5 to 25, 2020. The estimated completion time for the questionnaire was 3 to 4 minutes. A list of current members of the Turkish Endodontic Society was obtained from its web site, and a link to the survey was sent via social media (Instagram) and e-mail to all members. Of the 620 people the survey reached, 203 responded to the questionnaire.

The participants were asked to record the following:

- Demographic data (gender, age, professional experience, education level, and place of work).
- Information about COVID-19 (frequency of going to work, the endodontic diseases treated, and the preferred methods of communication with patients during the COVID-19 pandemic).

- Treatment approaches the respondents would apply to seven cases selected among patients who presented to the Department of Endodontics, Faculty of Dentistry, Istanbul Medipol University, between March 16 and April 23, 2020.

All clinical cases were structured as multiple-choice questions, and each participant was requested to choose only one treatment option for each case. However, participants were able to select more than one option to answer the following questions: "Which of the following diseases did you treat during the COVID-19 pandemic?" and "How do you communicate with the patients during the COVID-19 pandemic?" The respondents could choose from the following seven treatment options:

1. Prescribe antibiotics and/or painkillers and postpone treatment.
2. Start endodontic treatment but postpone full treatment by removing coronal pulp tissue only.
3. Start endodontic treatment but postpone full treatment by placing a material-like devitalizing/eugenol liquid on the pulp.
4. Start endodontic treatment but postpone full treatment by placing antibacterial medicament into the root canals.
5. Start endodontic treatment and complete all treatment procedures.
6. Tooth extraction.
7. Follow-up.

The participants were asked to select a treatment approach for the following seven cases, considering their current situation during the COVID-19 outbreak:

Case 1 (symptomatic apical periodontitis): A 51-year-old systemically healthy female patient presents with a complaint of severe pain lasting for a week in the left mandibular molar region. The patient received fixed prosthetic

restoration on the painful area a few months prior. There is no periapical swelling. What is your treatment approach for tooth 37? (► Fig. 1A).

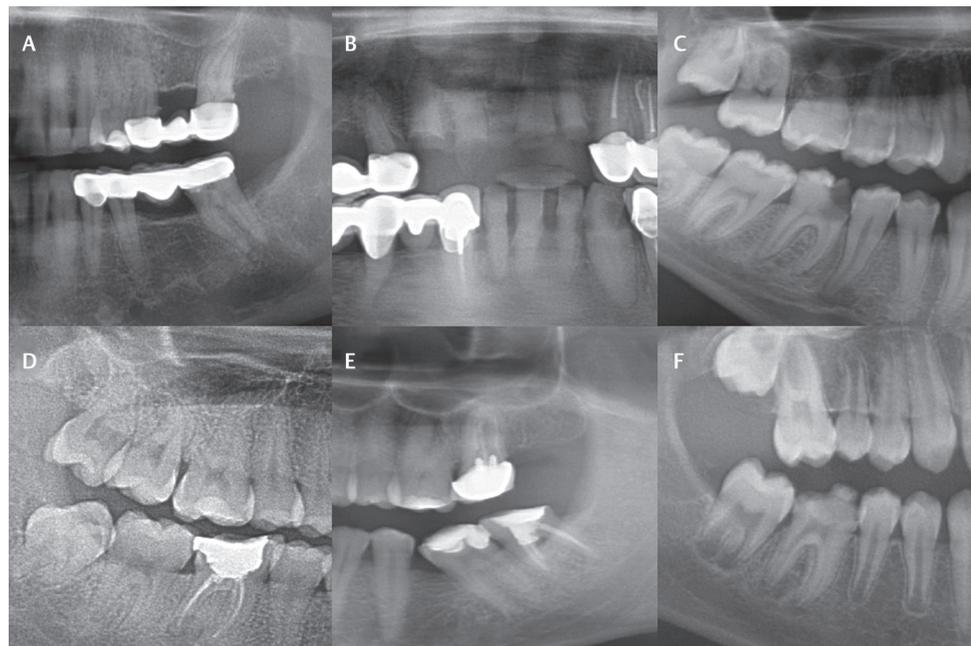
Case 2 (chronic apical periodontitis): A 74-year-old systemically healthy male patient presents with a fall in a 25-year bridge in the maxillary anterior region. All teeth under the bridge are devastated to the cemento-enamel junction but there is no pain or swelling. What is your treatment approach for tooth 21? (► Fig. 1B).

Case 3 (acute apical abscess): A 17-year-old systemically healthy male patient presents with a complaint of severe pain lasting five days in the right mandibular molar region. Tooth 46 has profound caries with positive percussion and palpation. There is intraoral swelling in the apical of tooth 46. What is your treatment approach for tooth 46? (► Fig. 1C).

Case 4 (third molar tooth with endodontic symptoms): A 40-year-old systemically healthy female patient presents with a complaint of severe pain for 3 days in the upper right molar region. Severe percussion sensitivity is present in teeth 17 and 18. There is no caries on tooth 17. On tooth 18, there is a profound caries on the buccal surface, palpation is negative, and there is no intraoral swelling. What is your treatment approach for tooth 18? (► Fig. 1D).

Case 5 (asymptomatic case required retreatment): A 22-year-old systemically healthy female patient presents with a fracture in the right mandibular molar region. The patient received root canal treatment of tooth 46, 3 years ago, and there is a limited fracture in the coronal restoration. The patient has no discomfort other than sensitivity observed occasionally during chewing. Percussion and palpations are negative, and there is no swelling. What is your treatment approach for tooth 46? (► Fig. 1D).

Case 6 (symptomatic case required retreatment): A 55-year-old systemically healthy male patient presents



**Fig. 1** Radiographies of the cases in the survey. (A) Radiography of case 1. (B) Radiography of case 2. (C) Radiography of case 3. (D) Radiography of cases 4 and 5. (E) Radiography of case 6. (F) Radiography of case 7.

with severe pain in the maxillary left molar region. The patient received root canal treatment of tooth 27, 5 years ago. Tooth 27 has severe percussion sensitivity, palpation is negative, and there is no swelling. What is your treatment approach for tooth 27? (►Fig. 1E).

Case 7 (symptomatic irreversible pulpitis): A 10-year-old systemically healthy male patient presents with severe pain in the lower right molar region. Tooth 46 has severe percussion sensitivity, and there is a long-term complaint of severe pain that begins spontaneously. There is no swelling. What is your treatment approach for tooth 46? (►Fig. 1F).

### Statistical Analysis

The obtained data were exported as a Microsoft Excel (2007) spreadsheet (Microsoft Office, Redmond, California, United States). Statistical evaluation was performed using SPSS statistical software program (SPSS 22.0, SPSS Inc., Chicago, Illinois, United States). Descriptive statistics (frequencies) were calculated for all the recorded variables for each group. Differences of the measured variables were assessed using a Chi-square test. A *p*-value of <0.05 was considered significant for all tests.

### Results

A total of 203 PhD students and endodontists participated in the present study, giving a response rate of 28.8%. All participants completed the questionnaires, and there were no missing answers. Of the participants, 65.5% were females (*n* = 133) and 34.5% were males (*n* = 70). Most of the participants were aged 31 to 40 years (45.3%, *n* = 92), followed by 20 to 30 years (41.4%, *n* = 84), 41 to 50 years (9.9%, *n* = 20), and 51 to 60 years (3.0%, *n* = 6); only one participant was aged over 61 (0.5%). While 34% of the participants had less than 5 years' experience (*n* = 69), 44.3% had 6 to 15 years (*n* = 90), 16.3% had 16 to 25 years (*n* = 33), and 5.4% had more than 25 years of experience (*n* = 11). Of the participants, 62.6% were endodontists (*n* = 127), and 37.4% were PhD students in endodontics (*n* = 76). Among the respondents, 68% worked at university clinics (*n* = 138), 21.2% at private clinics (*n* = 43), and 10.8% at

public clinics (*n* = 22). While 23.2% of the participants stated that they did not go to the clinic/hospital during the pandemic period (*n* = 47), 7.9% went once a month (*n* = 16), 22.2% went twice a month (*n* = 45), 31% went once a week (*n* = 63), 13.3% went twice a week or more (*n* = 27), and 2.5% stated that they went to the clinic every day (*n* = 5). During the COVID-19 pandemic, the participants reported that 82.3% of treated cases were acute apical abscess (*n* = 167), 78.8% were symptomatic irreversible pulpitis (*n* = 160), and 68.5% were symptomatic apical periodontitis (*n* = 139; ►Table 1). To communicate with their patients, 58.1% stated that they were face to face (*n* = 118), 55.2% were by phone (*n* = 112), 10.8% were via social media (*n* = 22), and 3.9% used video conferencing (*n* = 8).

For case 1, 42.4% of the participants chose to prescribe antibiotics and/or painkillers and postpone the treatment (*n* = 86), followed by 23.6%, who opted to start endodontic treatment but postpone the treatment by placing the antibacterial medicament into the root canals (*n* = 48; ►Fig. 2A). For case 2, 48.3% preferred to follow-up with the patient (*n* = 98) and 16.7% opted to prescribe antibiotics and/or painkillers and postpone the treatment (*n* = 34; ►Fig. 2B). For case 3, 48.8% chose to start endodontic treatment but postpone the treatment by placing the antibacterial medicament into the root canals (*n* = 99), and 24.6% preferred to prescribe antibiotics and/or painkillers and postpone treatment (*n* = 50; ►Fig. 2C). For case 4, 54.7% preferred tooth extraction (*n* = 111), followed by 22.2%, who opted to prescribe antibiotics and/or painkillers and postpone the treatment (*n* = 45; ►Fig. 2D). For case 5, 65.5% decided to follow-up (*n* = 133), and 15.8% opted to prescribe antibiotics and/or painkillers and postpone the treatment (*n* = 32; ►Fig. 2E). For case 6, 38.4% chose to prescribe antibiotics and/or painkillers and postpone the treatment (*n* = 78), and 21.7% preferred to extract the tooth (*n* = 44; ►Fig. 2F). For case 7, 38.9% preferred to start endodontic treatment but postpone the treatment by placing the medicament into the root canals (*n* = 79), and 15.3% preferred to start endodontic treatment and complete the treatment procedures (*n* = 31; ►Fig. 2G).

**Table 1** Information about the diseases treated by the participants during the COVID-19 pandemic

		Responses		Cases (%)
		<i>n</i>	Percentage	
"Which of the following diseases did you treat during the COVID-19 pandemic?"	Reversible pulpitis	21	4.05	10.34
	Symptomatic irreversible pulpitis	160	30.83	78.82
	Asymptomatic apical periodontitis	7	1.35	3.45
	Symptomatic apical periodontitis	139	26.78	68.47
	Chronic apical abscess	8	1.54	3.94
	Acute apical abscess	167	32.18	82.27
	Retreatment	15	2.89	7.39
	Regenerative endodontic treatment	2	0.39	0.99
Total		519	100.00	242.36

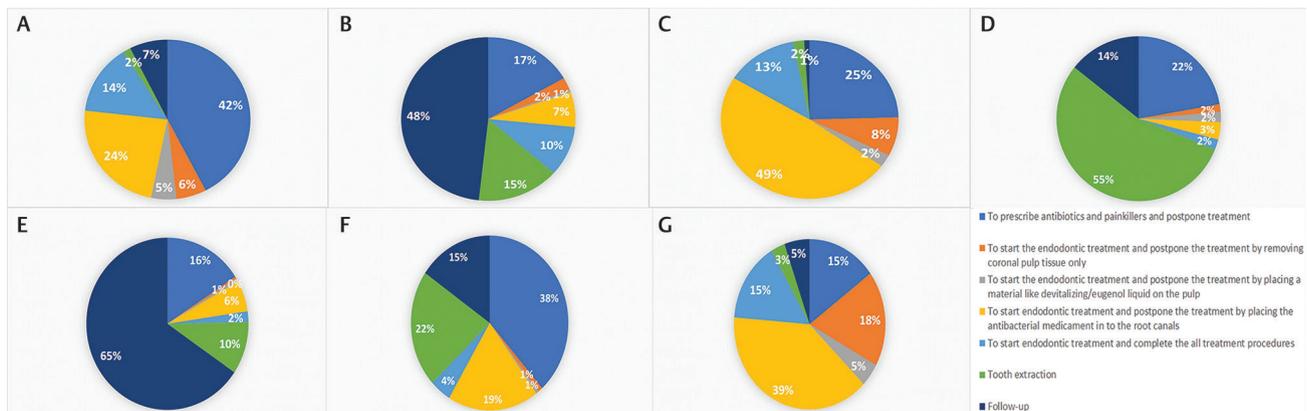
Abbreviation: COVID-19, novel coronavirus disease 2019.

A statistically significant difference was found between the female and male participants about treatment approaches for cases 1, 3, 6, and 7 ( $p < 0.05$ ; **Table 2**). For cases 1 and 6, female participants mostly chose to prescribe antibiotics and/or painkillers and postpone the treatment; and for case 7, female participants preferred to start endodontic treatment but postpone the treatment by placing the antibacterial medicament into the root canals ( $p < 0.05$ ). For case 3, male participants preferred to start endodontic treatment but postpone the treatment by placing the antibacterial medicament into the root canals ( $p < 0.05$ ).

A statistically significant difference was observed between the age groups regarding the treatment approaches selected for cases 1, 2, and 4 ( $p < 0.05$ ;

**Table 3**). For case 1, age groups preferred to prescribe antibiotics and/or painkillers and postpone the treatment ( $p < 0.05$ ). For case 2, follow-up was the most common treatment approach for participants in the 20 to 30 and 31 to 40 years of age groups ( $p < 0.05$ ). However, those in the 41 to 50 years of age group opted to prescribe antibiotics and/or painkillers and postpone treatment or follow-up equally for case 2, showing a significant difference from the other options ( $p < 0.05$ ). For case 4, all age groups preferred tooth extraction as the most common treatment approach ( $p < 0.05$ ).

Regarding professional experience, all experience levels opted to follow-up with the patient in case 2, showing a statistically significant difference ( $p < 0.05$ ; **Table 4**).



**Fig. 2** Graphs showing the distribution of participants' treatment approaches for the cases in the survey. (A) Graph showing results of case 1. (B) Graph showing results of case 2. (C) Graph showing results of case 3. (D) Graph showing results of case 4. (E) Graph showing results of case 5. (F) Graph showing results of case 6. (G) Graph showing results of case 7. Blue: To prescribe antibiotics and painkillers and postpone treatment; Orange: To start the endodontic treatment and postpone the treatment by removing coronal pulp tissue only; Grey: To start the endodontic treatment and postpone the treatment by placing a material like devitalizing / eugenol liquid on the pulp; Yellow: To start endodontic treatment and postpone the treatment by placing the antibacterial medicament in to the root canals; Light Blue: To start endodontic treatment and complete the all treatment procedures; Green: Tooth extraction; Navy Blue: Follow-up.

**Table 2** Distribution of participants' responses to cases by gender

		1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	$\chi^2$ <sup>b</sup>	<i>p</i> -Value
Case 1	Female	49.6	5.3	6.8	20.3	11.3	0.0	6.8	17.894	0.007 <sup>a</sup>
	Male	28.6	7.1	1.4	30.0	20.0	4.3	8.6		
Case 2	Female	17.3	1.5	0.8	6.0	7.5	13.5	53.4	7.448	0.281
	Male	15.7	4.3	0.0	8.6	14.3	18.6	38.6		
Case 3	Female	30.1	7.5	3.0	47.4	9.8	0.8	1.5	12.89	0.045 <sup>a</sup>
	Male	14.3	8.6	1.4	51.4	20.0	4.3	0.0		
Case 4	Female	24.1	0.8	2.3	3.8	0.8	56.4	12.0	6.753	0.344
	Male	18.6	2.9	1.4	2.9	4.3	51.4	18.6		
Case 5	Female	19.5	0.8	0.8	4.5	1.5	9.0	63.9	6.685	0.351
	Male	8.6	0.0	0.0	8.6	2.9	11.4	68.6		
Case 6	Female	44.4	0.0	0.8	16.5	1.5	21.8	15.0	16.326	0.012 <sup>a</sup>
	Male	27.1	2.9	0.0	22.9	10.0	21.4	15.7		
Case 7	Female	16.5	20.3	4.5	42.9	8.3	3.0	4.5	16.233	0.013 <sup>a</sup>
	Male	11.4	14.3	4.3	31.4	28.6	2.9	7.1		

<sup>a</sup> $p < 0.05$ .

<sup>b</sup>Chi-square test. (1) To prescribe antibiotics and painkillers and postpone treatment; (2) to start the endodontic treatment and postpone the treatment by removing coronal pulp tissue only; (3) to start the endodontic treatment and postpone the treatment by placing a material like devitalizing/eugenol liquid on the pulp; (4) to start endodontic treatment and postpone the treatment by placing the antibacterial medicament in to the root canals; (5) to start endodontic treatment and complete the all treatment procedures; (6) tooth extraction; (7) follow-up.

**Table 3** Distribution of participants' responses to cases by age groups

Case and age (y)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	$\chi^2$ <sup>b</sup>	p-Value
Case 1	20–30	44.0	2.4	8.3	23.8	7.1	3.6	33.058	0.016 <sup>a</sup>
	31–40	38.0	6.5	2.2	25.0	22.8	0.0		
	41–50	55.0	20.0	0.0	20.0	5.0	0.0		
	50+	42.9	0.0	14.3	14.3	14.3	0.0		
Case 2	20–30	16.7	2.4	0.0	7.1	7.1	17.9	45.632	0.001 <sup>a</sup>
	31–40	15.2	2.2	0.0	6.5	9.8	13.0		
	41–50	30.0	5.0	0.0	5.0	10.0	20.0		
	50+	0.0	0.0	14.3	14.3	42.9	0.0		
Case 3	20–30	21.4	10.7	3.6	51.2	8.3	2.4	18.01	0.455
	31–40	28.3	5.4	1.1	48.9	15.2	1.1		
	41–50	30.0	5.0	5.0	40.0	15.0	5.0		
	50+	0.0	14.3	0.0	42.9	42.9	0.0		
Case 4	20–30	16.7	0.0	2.4	1.2	0.0	66.7	31.266	0.027 <sup>a</sup>
	31–40	27.2	1.1	2.2	3.3	3.3	46.7		
	41–50	25.0	5.0	0.0	15.0	5.0	40.0		
	50+	14.3	14.3	0.0	0.0	0.0	57.1		
Case 5	20–30	15.5	1.2	0.0	6.0	2.4	7.1	15.618	0.619
	31–40	15.2	0.0	1.1	7.6	0.0	13.0		
	41–50	20.0	0.0	0.0	0.0	5.0	5.0		
	50+	14.3	0.0	0.0	0.0	14.3	14.3		
Case 6	20–30	35.7	2.4	1.2	17.9	2.4	19.0	14.223	0.714
	31–40	41.3	0.0	0.0	19.6	5.4	21.7		
	41–50	45.0	0.0	0.0	15.0	5.0	30.0		
	50+	14.3	0.0	0.0	28.6	14.3	28.6		
Case 7	20–30	15.5	20.2	7.1	34.5	11.9	2.4	14.765	0.678
	31–40	14.1	15.2	3.3	41.3	18.5	3.3		
	41–50	20.0	15.0	0.0	40.0	20.0	5.0		
	50+	0.0	42.9	0.0	57.1	0.0	0.0		

<sup>a</sup> $p < 0.05$ .<sup>b</sup>Chi-square test. (1) To prescribe antibiotics and painkillers and postpone treatment; (2) to start the endodontic treatment and postpone the treatment by removing coronal pulp tissue only; (3) to start the endodontic treatment and postpone the treatment by placing a material like devitalizing/eugenol liquid on the pulp; (4) to start endodontic treatment and postpone the treatment by placing the antibacterial medication into the root canals; (5) to start endodontic treatment and complete the all treatment procedures; (6) tooth extraction; (7) follow-up.

In terms of education level, both endodontists and PhD students most frequently chose to prescribe antibiotics and/or painkillers and postpone treatment for case 1, showing a statistically significant difference ( $p < 0.05$ ; ►Table 5).

For cases 1, 3, 5, and 7, a significant difference was found regarding participants' place of work ( $p < 0.05$ ; ►Table 6). For case 1, participants working at a university and at public clinics chose most commonly to prescribe antibiotics and/or painkillers and postpone treatment, while participants working in the private sector chose to start endodontic treatment and complete all the treatment procedures ( $p < 0.05$ ). However, for cases 3 and 7, all groups preferred to start endodontic treatment but postpone the treatment by placing the antibacterial medication into the root canals, and for case 5, follow-up was

the most common treatment approach with a significant difference ( $p < 0.05$ ).

## Discussion

As in many countries worldwide, the spread of COVID-19 has increased in Turkey.<sup>17</sup> Studies to develop an effective drug and vaccine specific to 2019-nCoV are continuing rapidly all over the world. Since the beginning of the pandemic, important steps have been taken in this regard. With the start of the normalization process, dentists have started to accept patients again to supply the increasing need for dental health services.<sup>18</sup> Therefore, considering that the incubation period of the disease may extend up to 24 days,<sup>9,10</sup> it may be inevitable to provide services in the same environment for patients with and without COVID-19.

**Table 4** Distribution of participants' responses to cases by professional experience

Case and age (y)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	$\chi^2$ <sup>b</sup>	p-Value
Case 1	<5	43.5	2.9	10.1	24.6	4.3	2.9	24.051	0.152
	6–15	42.2	6.7	2.2	23.3	20.0	1.1		
	16–25	42.4	12.1	0.0	24.2	15.2	0.0		
	>25	36.4	0.0	9.1	18.2	27.3	0.0		
Case 2	<5	18.8	2.9	0.0	7.2	5.8	18.8	34.214	0.012 <sup>a</sup>
	6–15	14.4	2.2	0.0	5.6	10.0	14.4		
	16–25	24.2	3.0	0.0	9.1	9.1	15.2		
	>25	0.0	0.0	9.1	9.1	36.4	0.0		
Case 3	<5	21.7	13.0	4.3	50.7	5.8	1.4	23.498	0.172
	6–15	30.0	3.3	1.1	46.7	16.7	2.2		
	16–25	24.2	9.1	3.0	48.5	12.1	3.0		
	>25	0.0	9.1	0.0	54.5	36.4	0.0		
Case 4	<5	15.9	0.0	4.3	0.0	0.0	68.1	25.113	0.122
	6–15	26.7	1.1	1.1	3.3	3.3	48.9		
	16–25	24.2	3.0	0.0	9.1	3.0	42.4		
	>25	18.2	9.1	0.0	9.1	0.0	54.5		
Case 5	<5	18.8	1.4	0.0	5.8	0.0	5.8	25.317	0.116
	6–15	15.6	0.0	1.1	7.8	1.1	12.2		
	16–25	9.1	0.0	0.0	3.0	3.0	12.1		
	>25	18.2	0.0	0.0	0.0	18.2	9.1		
Case 6	<5	40.6	2.9	1.4	17.4	0.0	15.9	27.65	0.068
	6–15	38.9	0.0	0.0	21.1	7.8	20.0		
	16–25	39.4	0.0	0.0	12.1	0.0	36.4		
	>25	18.2	0.0	0.0	27.3	18.2	27.3		
Case 7	<5	17.4	21.7	8.7	36.2	7.2	1.4	21.35	0.262
	6–15	14.4	15.6	3.3	35.6	23.3	3.3		
	16–25	15.2	15.2	0.0	45.5	12.1	6.1		
	>25	0.0	27.3	0.0	63.6	9.1	0.0		

<sup>a</sup>p < 0.05.<sup>b</sup>Chi-square test. (1) to prescribe antibiotics and painkillers and postpone treatment; (2) to start the endodontic treatment and postpone the treatment by removing coronal pulp tissue only; (3) to start the endodontic treatment and postpone the treatment by placing a material like devitalizing/eugenol liquid on the pulp; (4) to start endodontic treatment and postpone the treatment by placing the antibacterial medication in to the root canals; (5) to start endodontic treatment and complete the all treatment procedures; (6) tooth extraction; (7) follow-up.

To investigate the different approaches of endodontics specialists and PhD students to endodontic emergencies during the COVID-19 pandemic, an internet-based questionnaire was sent to 704 Turkish Endodontic Society members, and the results were evaluated. The participation rate was 28.8%. Similar to other questionnaire-based studies performed during the COVID-19 outbreak, the ratio between female and male participants was not equal.<sup>19-22</sup>

According to the data obtained from the respondents, the most frequently treated endodontic diseases during the COVID-19 pandemic were “acute apical abscess (32.2%),” “symptomatic irreversible pulpitis (30.8%),” and “symptomatic apical periodontitis (26.8%).” According to the findings of a recent study,<sup>14</sup> which examined the characteristics of endodontic emergencies during the COVID-19 outbreak in Wuhan, the majority of endodontic emergency diagnoses are “symptomatic irreversible pulpitis (53.13%).” Similar to the

findings of Yu et al,<sup>14</sup> in the current survey, the incidence of symptomatic irreversible pulpitis, symptomatic apical periodontitis, and acute apical abscess presented higher rates than other endodontic diseases.

Pain and swelling caused by pulpal infection constitute the majority of endodontic emergencies. The Turkish Ministry of Health Coronavirus Science Committee held on March 23, 2020, included endodontic diseases in the definition of “emergency practices in dentistry.”<sup>23</sup> In addition, the COVID-19 guidebook published by the Turkey Ministry of Health recommends that emergency dental treatments be performed and nonemergency practices postponed.<sup>17</sup> The findings of this study coincided with this suggestion. Overall, the participants of this study preferred the following three treatment approaches for the seven selected cases: (1) prescribe antibiotics and/or painkillers and postpone the treatment, (2) follow-up, and

**Table 5** Distribution of participants' responses to cases by education level

		1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	$\chi^2$ <sup>a</sup>	p-Value
Case 1	Endodontists	40.9	6.3	2.4	22.8	20.5	0.0	7.1	19.013	0.004 <sup>a</sup>
	PhD students in endodontics	44.7	5.3	9.2	25.0	3.9	3.9	7.9		
Case 2	Endodontists	13.4	2.4	0.8	7.1	11.8	15.0	49.6	4.388	0.624
	PhD students in endodontics	22.4	2.6	0.0	6.6	6.6	15.8	46.1		
Case 3	Endodontists	24.4	5.5	1.6	48.8	16.5	1.6	1.6	7.646	0.265
	PhD students in endodontics	25.0	11.8	3.9	48.7	7.9	2.6	0.0		
Case 4	Endodontists	25.2	2.4	1.6	3.9	3.1	47.2	16.5	10.73	0.097
	PhD students in endodontics	17.1	0.0	2.6	2.6	0.0	67.1	10.5		
Case 5	Endodontists	15.0	0.8	0.8	7.1	1.6	12.6	62.2	5.563	0.474
	PhD students in endodontics	17.1	0.0	0.0	3.9	2.6	5.3	71.1		
Case 6	Endodontists	39.4	0.0	0.0	17.3	6.3	21.3	15.7	8.186	0.225
	PhD students in endodontics	36.8	2.6	1.3	21.1	1.3	22.4	14.5		
Case 7	Endodontists	15.0	16.5	3.9	37.8	18.9	2.4	5.5	4.169	0.654
	PhD students in endodontics	14.5	21.1	5.3	40.8	9.2	3.9	5.3		

<sup>a</sup>p < 0.05.

<sup>b</sup>Chi-square test. (1) to prescribe antibiotics and painkillers and postpone treatment; (2) to start the endodontic treatment and postpone the treatment by removing coronal pulp tissue only; (3) to start the endodontic treatment and postpone the treatment by placing a material like devitalizing/eugenol liquid on the pulp; (4) to start endodontic treatment and postpone the treatment by placing the antibacterial medication in to the root canals; (5) to start endodontic treatment and complete the all treatment procedures; (6) tooth extraction; (7) follow-up.

(3) start endodontic treatment but postpone the treatment by placing the antibacterial medicament into the root canals." These results are consistent with the recommendations given in a recent study for endodontic emergency treatments during the COVID-19 pandemic.<sup>10</sup> However, the option to perform a full pulpotomy as recommended in the second management of "symptomatic irreversible pulpitis" and "symptomatic apical periodontitis" in that study<sup>10</sup> was less preferred by the respondents in the current study. The cases included in this survey were selected among real patients who presented to the Istanbul Medipol University Faculty of Dentistry clinics during the COVID-19 pandemic. The distribution of cases represents different endodontic diseases. According to the results for case 1 corresponding to "symptomatic apical periodontitis," the option to prescribe antibiotics and painkillers and postpone the treatment was the most frequently marked treatment approach (42.4%). These results supported the study by Ather et al<sup>10</sup> for the primary management of pain in "symptomatic apical periodontitis" and "symptomatic irreversible pulpitis." However, different from Ather et al,<sup>10</sup> the most preferred treatment option for case 7 representing "symptomatic irreversible pulpitis" was to start endodontic treatment but postpone the treatment by placing the antibacterial medicament into the root canals (total pulpectomy; 39%). However, the full pulpotomy method significantly shortens the duration

of treatment and relieves the patient's acute symptoms quickly and effectively.<sup>24</sup> Thus, a full pulpotomy is suitable for reducing the risk of spreading COVID-19 than a total pulpectomy and for effectively eliminating the patient's acute symptoms. While the recommended method for the primary management of acute apical abscess during the COVID-19 pandemic was drainage and pharmacologic therapy,<sup>10</sup> the results of case 3 showed that "starting endodontic and postponing the treatment by placing antibacterial medicament into the root canals" was the preferred method, referred to as "acute apical abscess" in the present study. While it is possible to agree with the recommendation of Ather et al<sup>10</sup> in cases where an acute abscess can be managed with drainage and medical drug use, it may be better to adopt the full pulpectomy approach during the COVID-19 pandemic in cases where abscess drainage is not possible or when the disease recurs. For cases 5 and 6, the respective treatment approaches preferred for retreatment were to follow-up (65.5%) and prescribe antibiotics and/or painkillers and postpone the treatment (38.4%). The participants chose different treatment approaches because case 6 is symptomatic. Possible reasons for postponing retreatment in cases 5 and 6 include a lower chance of success compared with primary root canal treatment, prolonged treatment procedures, repeated visits to the clinic, and complicating the treatment process.<sup>25</sup> Finally, for case 2, which represents "chronic apical periodontitis," the

**Table 6** Distribution of participants' responses to cases by working place

		1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	$\chi^2$ <sup>a</sup>	p-Value
Case 1	University clinics	46.4	5.8	5.8	22.5	8.0	2.2	9.4	31.495	0.002
	Private clinics	23.3	7.0	4.7	23.3	37.2	0.0	4.7		
	Public clinics	54.5	4.5	0.0	31.8	9.1	0.0	0.0		
Case 2	University clinics	18.1	2.9	0.7	8.0	7.2	15.2	47.8	11.471	0.489
	Private clinics	16.3	0.0	0.0	4.7	20.9	14.0	44.2		
	Public clinics	9.1	4.5	0.0	4.5	4.5	18.2	59.1		
Case 3	University clinics	25.4	9.4	3.6	50.0	8.0	2.2	1.4	28.196	0.005
	Private clinics	16.3	4.7	0.0	44.2	34.9	0.0	0.0		
	Public clinics	36.4	4.5	0.0	50.0	4.5	4.5	0.0		
Case 4	University clinics	19.6	0.7	2.2	4.3	0.7	57.2	15.2	16.985	0.15
	Private clinics	23.3	4.7	0.0	2.3	7.0	51.2	11.6		
	Public clinics	36.4	0.0	4.5	0.0	0.0	45.5	13.6		
Case 5	University clinics	15.9	0.0	0.0	1.4	2.2	9.4	71.0	34.413	0.001
	Private clinics	9.3	2.3	0.0	18.6	2.3	11.6	55.8		
	Public clinics	27.3	0.0	4.5	9.1	0.0	9.1	50.0		
Case 6	University clinics	35.5	1.4	0.7	18.1	2.2	25.4	16.7	20.106	0.065
	Private clinics	37.2	0.0	0.0	23.3	14.0	11.6	14.0		
	Public clinics	59.1	0.0	0.0	13.6	0.0	18.2	9.1		
Case 7	University clinics	15.9	19.6	3.6	37.0	11.6	4.3	8.0	23.829	0.021
	Private clinics	9.3	16.3	9.3	34.9	30.2	0.0	0.0		
	Public clinics	18.2	13.6	0.0	59.1	9.1	0.0	0.0		

<sup>a</sup> $p < 0.05$ .<sup>b</sup>Chi-square test. (1) to prescribe antibiotics and painkillers and postpone treatment; (2) to start the endodontic treatment and postpone the treatment by removing coronal pulp tissue only; (3) to start the endodontic treatment and postpone the treatment by placing a material like devitalizing/eugenol liquid on the pulp; (4) to start endodontic treatment and postpone the treatment by placing the antibacterial medicament in to the root canals; (5) to start endodontic treatment and complete the all treatment procedures; (6) tooth extraction; (7) follow-up.

respondents preferred the follow-up option (48.3%), most likely because of the absence of pain or history of periapical swelling. This result is a suitable approach to case 2 to reduce the risk of spreading COVID-19 and to avoid endangering the patient's health for a nonemergency dental treatment. For case 4, 54.7% of the participants opted to extract the third molar tooth. This preference may relate to the possibility of complications occurring during the endodontic treatment of third molar teeth, difficulty accessing the tooth, the possibility of encountering an abnormal root canal structure, and differences in the eruption pattern. If adjacent teeth are present in the mouth and are intact, it may be possible to extract these teeth. However, the positive aspects of this approach include that these teeth do not require a prosthetic restoration following the extraction and thus effectively eliminate the endodontic emergency. Depending on the characteristics of the case and the dental professional's experience, minimally invasive dental treatments (MIDT) may be recommended in cases with such profound caries with no signs of periapical infection and intact coronal integrity. MIDT for deep dentin caries are conservative techniques that preserve the tooth structure as much as possible and prevent irreversible pulp damage. These techniques, which include atraumatic restorative treatment (ART) and selective

caries tissue removal (e.g., indirect pulp capping, stepwise removal, and selective removal to soft dentine),<sup>26</sup> are valuable during the COVID-19 pandemic because they reduce aerosol formation in the environment and minimize the need for endodontic treatment and subsequent prosthetic rehabilitation, thus lowering the risk of transmission. Among these treatments, ART is an MIDT method that is supported by scientific evidence, limits the removal of natural tooth structure, has a positive effect on the patient's quality of life, and is cost effective.<sup>26,27</sup> In the profound caries lesions extending into the pulpal third or quarter of the dentine radiographically, selective removal to soft dentine or stepwise removal with the advantage of not requiring a second visit may also be an appropriate treatment option.<sup>26,28</sup> In cases that require root canal treatment, treatment should be completed as soon as possible and in a single session without sacrificing quality, thus reducing exposure of the patient and the dental team to the virus during treatment and preventing the spread of the disease due to repeated sessions. The use of a rubber dam during endodontic treatment is important for reducing aerosol formation significantly. In addition, working with a dental loop or an operation microscope is preferred because it allows the patient to work at a certain distance and also facilitates the dentist's work in solving some complex

clinical problems that were previously not possible without the help of magnifying devices.<sup>29</sup>

## Conclusion

In conclusion, deep carious teeth should be treated with minimally invasive methods as much as possible, and the treatment should be delayed by eliminating the patient's acute symptoms during the pandemic process for teeth that require root canal treatment. In the postpandemic process, it should be aimed to complete the treatment in a single session and optimum time taking the necessary precautions in a safe environment.

### Note

The results of this study were presented as a poster presentation at IAPD20 Virtual on September 13–17, 2020.

### Ethical Approval

Ethical approval of the study design was obtained from the Institutional Review Board of Istanbul Medipol University (Approval Number:10840098–604.01.01-E.14696/326) and Ministry of Health of Turkey. Verbal consent was obtained from the patients whose radiographs were used for reference in the study. Additionally, all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

### Authors' Contributions

K.O.: conceptualization, methodology, software data curation, preparing the original draft; S.I.Y.: methodology, visualization, investigation, reviewing and editing the manuscript.

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### Conflict of Interest

None declared.

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