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# A Cross-sectional Survey on the Impact of Coronavirus Disease 2019 on the Clinical Practice of Endodontists across the United States



## SIGNIFICANCE

Endodontists need to be aware and prepared for root canal treatment during COVID-19 pandemic outbreak. Additional protection measurements than PPE are needed. Endodontists must comply with the guidelines released by the World Health Organization and dental associations.

## ABSTRACT

This survey investigated the effect of the coronavirus disease 2019 (COVID-19) pandemic on the clinical practice of endodontics among the American Association of Endodontists (AAE) members by evaluating the impact on clinical activities, patient screening, infection control measurements, potential transmission, clinical protocols, as well as psychological concerns. A descriptive, cross-sectional survey was developed to query AAE members from all 7 districts. The survey consisted of 24 questions, 8 demographic questions and 16 questions related to the COVID-19 pandemic impact on the clinical practice. A total of 454 AAE members participated in the survey. As of July 2020, most endodontists were active in front-line treatment of dental patients (82%). N95 respirator face mask was described by 83.1% of the participants as special measures beyond the regular personal protective equipment. Rubber dam isolation was recognized by the majority of the participants at some level to reduce the chance of COVID-19 cross infection. Most of the endodontist participants acknowledged trauma followed by swelling, pain, and postoperative complication to be emergencies. The majority of respondents reported being concerned about the effect of COVID-19 on their practice. No differences in worries about COVID-19 infection were related to demographics ( $P > .05$ ). The majority of the endodontists are aware of the COVID-19 pandemic, are taking special precautions, and are concerned about contracting and spreading the virus. Despite the conflict between their roles as health care providers and family members with the potential risk of exposing their families, most of them remain on duty providing front-line care for dental treatment. (*J Endod* 2021;47:28–38.)

## KEY WORDS

COVID-19; dental; endodontics; root canal; SARS-CoV-2

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There was an outbreak of coronavirus disease 2019 (COVID-19) in late December 2019<sup>1</sup>. The World Health Organization (WHO) declared a public health emergency of international concern over this pandemic outbreak on January 30, 2020. Since then, the number of cases and confirmed deaths has increased globally, as indicated by the weekly operational update COVID-19 provided by WHO<sup>2,3</sup>.

As of now (August 21, 2020), there have been 21,294,845 cases confirmed and 761,779 deaths<sup>2</sup>. There is an interactive map of the global cases of COVID-19 by the Center for Systems Science and Engineering at Johns Hopkins University, which is continually updated<sup>3</sup>.

The COVID-19 disease is caused by the novel coronavirus severe acute respiratory syndrome-associated coronavirus 2 (SARS-CoV-2, formerly known as 2019-nCoV)<sup>4</sup>. The most commonly reported routes of SARS-CoV-2 transmission are inhalation or direct inoculation<sup>5</sup>. The inhalation may occur from respiratory droplets or aerosols from infected individuals within a 6-foot radius. In addition, the direct inoculation of SARS-CoV-2 infected particles occurs by touching surfaces contaminated with infected respiratory droplets as transmission via an inanimate vector<sup>5</sup>.

Because of the dual risk of high aerosol-generating procedures in dentistry plus saliva-borne SARS-CoV-2 in both symptomatic and asymptomatic individuals, dental societies/associations immediately responded to the COVID-19 disease. The response of dental associations to curb the

clinic-associated nosocomial transmission of SARS-CoV-2 varied at that time. At the early stage of the pandemic, the Public Health England under the guidance of the Chief Dental Officer<sup>6</sup> recommended not providing aerosol-generating procedures. Instead, they were screening and sending true emergencies to a central location where dentists were carrying out aerosol-generating procedures. In contrast, the American Dental Association guidelines at that time<sup>7</sup> restricted dental treatment to only addressing emergencies and reducing the number of routine check-ups and follow-up appointments. Despite the guidance, practitioners were still reluctant and felt fearful of treating patients in such a situation.

Endodontists are in a unique situation because they manage odontogenic pain, swelling, and dental alveolar trauma. Because of the chances to encounter patients suspected or confirmed with SARS-CoV-2, they had to act diligently to provide care and at the same time prevent nosocomial spread of the infection. For that, endodontists had to adopt special measurements to screen their patients, enhance infection control measurements, and follow specific dental treatment recommendations.

Here we assess endodontists' knowledge and awareness about COVID-19 disease. In addition, we evaluate the impact of COVID-19 on clinical activities, patient screening, infection control measurements, potential transmission, clinical protocols, and psychological concerns on the clinical practice of endodontists across the United States.

## MATERIALS AND METHODS

This survey was approved by the Institutional Review Board at the University of Maryland, Baltimore (#HP-00092103). A descriptive, cross-sectional survey was generated through Qualtrics (<http://umaryland.qualtrics.com>). The study population consisted of 5191 selected members of the American Association of Endodontists (AAE) from all 7 districts (I–VII) in the United States listed in the AAE directory website (2019–2020 membership directory). Invitations to participate in the study were emailed to each participant in June 2020. The invitations were sent 2 times, with 2 weeks apart. The survey remained open for 1 month, and afterward, data were collected. The data were collected in July 2020. The questions for this questionnaire were developed mostly on the basis of COVID-19 guidelines published by the Centers for Disease Control and Prevention, WHO, American Dental Association, and *Journal of Endodontics*. The survey instruments consisted of 2 sections with a total of 24 questions. The first section of

the questionnaire comprised 8 demographic questions and 16 questions regarding the COVID-19 pandemic impact in the clinical practice of endodontists (Table 1).

## Data Analysis

All data were transferred from the Qualtrics forms into Microsoft Excel (Microsoft Corp, Redmond, WA) and analyzed with the Statistical Package of the Social Sciences (SPSS, Version 25; IBM Corp, Armonk, NY). Descriptive statistics were used for the analysis. The generalized linear model with binary logistic regression was performed to explore the factors associated with the effect of COVID-19 on the clinical practice of endodontics and the independent variables including gender, years of experience, type of practice, location, nature of practice, participation in education, board certification, and practicing district. A *P* value less than .05 was considered significant (*P* < .05).

## RESULTS

From the 5191 invited to take the survey from all 7 AAE districts, 454 participated in the survey. Despite efforts through the survey design to prevent skipping questions, some respondents did not answer all the questions. A total of 324 men and 120 women participated in this survey (Table 1). A total of 324 respondents had practiced for more than 10 years. A greater number of respondents belonged to AAE District VI (70/395, 17.7%), I (65/395, 16.5%), followed by IV (59/454, 14.9%), and III (58/395, 14.7%) (Table 1). The 4 states with a greater number of participants were California, New York, followed by Maryland and North Carolina (Table 1). Most respondents have their practice located in the suburban (245/446, 54.9%) and urban (168/446, 37.7%) areas (Table 1). All participants were endodontists (454, 100%). Most of the respondents described their practice setting as a group of endodontists (182/443, 41.1%) and solo endodontist (170/443, 38.4%) (Table 1). The demographic information of participants is detailed in Table 1.

As of July 2020, 299/397 participants (75.3%) had fully resumed their practice, and 75/397 (18.9%) had partially returned to their practice (Table 1). From the participants who resumed their practice, 284/395 (72%) reported that the number of patients decreased compared with the same time a year ago. In comparison, only 17/454 (4%) reported no effect or an increase in the number of patients (Fig. 1A). As of July 2020, most endodontists took part in endodontic care in the front-line treatment of dental

patients (322/397, 82%) (Fig. 1B). Most of the participants acknowledged trauma (326/397, 82.1%) followed by swelling (325/397, 81.9%), pain (302/397, 76.1%), and postoperative complication (237/397, 59.7%) to be emergencies. Thirty-five percent of the participants reported all of the above emergencies (139/397, 35%) (Table 1).

The participants best described their current patient COVID-19 screening techniques as taking patient body temperature (373/396, 94.2%), and/or oral questions (349/396, 88%), and/or written questionnaire (307/396, 77.5%). Only a few participants (8/396, 2%) reported using reverse transcriptase polymerase chain reaction (RT-PCR) for COVID-19 screening. No respondent reported having requested chest x-ray for COVID-19 screening in dental practice. Most participants identified flu-like symptoms (376/397, 94.7%), body temperature > 100°F (371/397, 93.5%), cough (352/397, 88.7%), loss of smell (349/397, 87.9%), shortness of breath (339/397, 85.4%), being around someone diagnosed with COVID-19 (327/397, 82.4%), travel history (298/397, 75.1%), sore throat (281/397, 70.8%), as well as vomiting, diarrhea, and stomach pain (234/397, 58.9%) to be a positive response in their current patient screening technique (Table 1). Only 2% of the participants (6/454) reported uncooperative patients for the COVID-19 screening measurement adopted in their practice (Fig. 1C). In addition to the regular personal protective equipment (PPE), 100% of the participants reported having taken special protective measures for routine root canal therapy, with the most common ones being the N95 respirator face mask (330/397, 83.1%), face shield (234/397, 58.9%), and head cover (219/397, 55.2%) (Table 1). In addition, some respondents (168/397, 42.3%) reported implementing an air-purifying unit in their operatory (Table 1). Other protective measurements were also reported by the respondents (Table 1).

Most participants agreed at some level to be concerned with contracting/spreading the COVID-19 virus. Rubber dam isolation was recognized by the majority of the participants at some level to reduce the chance of COVID-19 cross infection from routine endodontic procedures. Two hundred ninety-eight participants (298/374, 80%) reported being worried about the effect of COVID-19 on their practice (Fig. 1D). The reasons behind their worries were mostly common staff and/or family becoming infected (Table 1). The majority of the participants agreed at different levels with the COVID-19 phase in their state. As of July 2020, most of the states were in phases 2 and 3 (Table 1). Most of the

**TABLE 1 - Demographic and COVID-19 Related Questions and Answers**

<b>Section 1: Demographic questions</b>			
Q1	What is your gender?		n = 444
		Male	324 (73%)
		Female	120 (27%)
		Other	0
Q2	How many years have you been in practice?		n = 447
		0–5	61 (13.6%)
		6–10	62 (13.9%)
		11–20	109 (24.4%)
		21–30	85 (19%)
		31–40	84 (18.8%)
		More than 40	46 (10.3%)
Q3	What best describes the nature of your practice?		n = 443
		Solo endodontist	170 (38.4%)
		Group of endodontists	182 (41.1%)
		Corporate	19 (4.3%)
		Military	11 (2.5%)
		Multi-specialty	10 (2.3%)
		Community/public health	0
		Faculty practice	8 (1.8%)
		Full-time educator	19 (4.3%)
		Part-time educator	9 (2.0%)
		Volunteer educator	0
		No teaching	1 (0.2%)
		Hospital	2 (0.5%)
		Other	12 (2.7%)
Q4	Which best describes the nature of your practice?		n = 454
		Endodontist	454 (100%)
		General dentist providing endodontic treatment	0
		Oral surgeon providing endodontic treatment	0
		Periodontist providing endodontic treatment	0
		Pediatric dentist providing endodontic treatment	0
Q5	How would you describe the location of your practice?		n = 446
		Rural	33 (7.4%)
		Urban	168 (37.7%)
		Suburban	245 (54.9%)

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**TABLE 1 - Continued**

<b>Section 1: Demographic questions</b>			
Q6	In which state do you currently reside?	AL, AK, AZ, AR, CA, CO, CT, DE, DC, FL, GA, HI, ID, IL IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, PR RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY	n = 381 AL (n = 2), AK (n = 1), AZ (n = 13), AR (n = 3), CA (n = 48), CO (n = 12), CT (n = 4) DE (n = 0), DC (n = 2), DE (n = 0), FL (n = 13), GA (n = 6), HI (n = 2), ID (n = 5), IL (n = 15) IN (n = 8), IA (n = 1), KS (n = 2), KY (n = 2), LA (n = 3), ME (n = 1), MD (n = 19) MA (n = 10), MI (n = 10), MN (n = 10), MS (n = 0), MO (n = 10), MT (n = 1), NE (n = 0) NV (n = 4), NH (n = 2), NJ (n = 9), NM (n = 3), NY (n = 21), NC (n = 19), ND (n = 1) OH (n = 14), OK (n = 0), OR (n = 10), PA (n = 18), PR (n = 1), RI (n = 0), SC (n = 7) SD (n = 0), TN (n = 7), TX (n = 23), UT (n = 2), VT (n = 1), VA (n = 12), WA (n = 7) WV (n = 4), WI (n = 0), WY (n = 2)
Q7	In which AAE district do you currently reside?	I (DE, DC, MA, MD, ME, NH, PA, VT, VA) II (CT, NJ, NY, RI) III (FL, GA, NC, SC, TN) IV (IL, IN, KY, MI, OH, WV, IN) V (AL, AR, AZ, LA, MS, NM, OK, PR, TX, VI, United States Armed Services, Veteran's Administration) Army, Navy, Veterans Administration, Virgin Islands VI (AK, CO, Guam, HI, ID, IA, KS, MN, MO, MT, NE) NV, ND, OR, SD, UT, WA, WY) VII (CA)	n = 395 65 (16.5%) 37 (9.4%) 58 (14.7%) 59 (14.9%) 54 (13.7%) 70 (17.7%) 52 (13.2%)
Q8	Are you Board Certified?	Yes Eligible None	n = 395 148 (37.5%) 173 (43.8%) 74 (18.7%)
<b>Section 2: COVID-19 pandemic-related questions</b>			
Q9	Have you returned to your practice?	No 25% 50% 75% 100% Emergency only	n = 397 19 (4.8%) 9 (2.3%) 25 (6.3%) 41 (10.3%) 299 (75.3%) 4 (1%)

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TABLE 1 - Continued

Section 2: COVID-19 pandemic-related questions				
Q10	Has the COVID-19 pandemic affected the number of patients in your practice when compared with the same time a year ago?		n = 395	
		No effect	94 (24%)	
		Decrease	284 (72%)	
		Increase	17 (4%)	
Q11	Are you taking part in endodontic care in front-line treatment of dental patients?		n = 397	
		Yes	322 (82%)	
		No	69 (18%)	
Q12	What do you classify as an emergency? Please select all that apply		n = 397	
		Swelling	325 (81.9%)	
		Trauma	326 (82.1%)	
		Pain	302 (76.1%)	
		Postoperative complication	237 (59.7%)	
		Loss of crown or temporary filling	79 (19.9%)	
		All of the above	139 (35%)	
Q13	Which best describe your current patient COVID-19 screening techniques? Please select all that apply		n = 396	
		Written questionnaire	307 (77.5%)	
		Oral questions	349 (88%)	
		Taking patient body temperature	373 (94.2%)	
		RT-PCR	8 (2%)	
		Another paid COVID-19 test	3 (0.7%)	
		Chest x-ray	0	
Q14	Which of the following do you identify as a positive response in your current patient screening techniques? Please select all that apply		n = 397	
		Body temperature higher than 100°F (38°C)	371 (93.5%)	Other specified
		Cough	352 (88.7%)	COVID-19 test ordered all aerosol-generating procedures
		Sore throat	281 (70.8%)	Temperature 100.4°F
		Shortness of breath	339 (85.4%)	Temperature over 101°F
		Flu-like symptoms	376 (94.7%)	COVID or no COVID, I would not want to see patients with any symptoms
		Muscle pain	207 (52.1%)	Diagnosis within the last 2 weeks of COVID-19
		Red or painful eyes, itching, or scratchy eyes	102 (25.7%)	
		Vomiting, diarrhea, stomach pain	234 (58.9%)	
		Loss of smell	349 (87.9%)	
		Runny nose	162 (40.8%)	
		Changes in toe or new toe condition	78 (19.6%)	

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**TABLE 1 - Continued**

Section 2: COVID-19 pandemic-related questions			
		Around someone diagnosed with COVID-19	327 (82.4%)
		Pulse oximeter below 90%	132 (33.2%)
		Travel history	298 (75.1%)
		Other (please specify)	6 (1.5%)
Q15	Are patients cooperative with added screening measures?		n = 391
		Yes	385 (98%)
		No	6 (2%)
Q16	Which of the following best describe the special measures you are now taking beyond regular PPE? Please select all that apply		n = 397
		N95 respirator face mask	330 (83.1%)
		Face shield	234 (58.9%)
		Protective suit	146 (36.8%)
		Head cover	219 (55.2%)
		Shoe covers	62 (15.6%)
		Oral aerosol vacuum	67 (16.9%)
		Plexiglass aerosol shield for microscope	114 (28.7%)
		Cold fogging	38 (9.6%)
		Negative pressure operatory for treating COVID-19 positive or suspected patients	13 (3.3%)
		Air purifying unit	168 (42.3%)
		Nothing special	23 (5.8%)
		Other	39 (9.8%)
		Other specified (9.8%)	
		Plastic shield from the microscope	1
		Retired	1
		Closed eye goggles	1
		Respirator mask	1
		Level 3 surgical mask	1
		Just go fogger	1
		Window fan exhausting outdoors	1
		Goggles	
		Air purifier in building central air	1
		K95	1
		UVC light for OP disinfection	1
		K95 mask due to lack of N95 availability	1
		Ventilation units	1
		Oral pre-rinse, bathe the tooth with rubbing alcohol and sodium hypochlorite after placing dental can and before using high speed	1
		UV light in between patients	1
Q17	Are you concerned about contracting or spreading SARS-CoV-2?		n = 374
		Strongly agree	147 (39.3%)
		Agree	92 (24.6%)
		Somewhat agree	65 (17.4%)
		Neither agree nor disagree	23 (6.1%)
		Somewhat disagree	14 (3.7%)
		Disagree	19 (5.1%)
		Strongly disagree	14 (3.7%)
Q18	Do you believe the rubber dam reduces the chance of COVID-19 cross infection from routine endodontic procedure?		n = 373

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TABLE 1 - Continued

Section 2: COVID-19 pandemic-related questions			
		Strongly agree	110 (29.5%)
		Agree	124 (33.2%)
		Somewhat agree	100 (26.8%)
		Neither agree nor disagree	12 (3.20%)
		Somewhat disagree	11 (2.9%)
		Disagree	12 (3.2%)
		Strongly disagree	4 (1.1%)
Q19	Are you worried about the effect of COVID-19 on your practice of endodontics?		n = 374
		Yes	298 (80%)
		No	76 (20%)
Q20	What is the reason behind your worries? Please select all that apply		n = 396
		I will become infected	243 (23.7%)
		My family will become infected	262 (25.5%)
		My staff will become infected	287 (28%)
		My patients will become infected	234 (22.8%)
Q21	Do you agree with the COVID-19 phase in your state?		n = 374
		Strongly agree	59 (15.8%)
		Agree	142 (38%)
		Somewhat agree	79 (21.1%)
		Neither agree nor disagree	25 (6.7%)
		Somewhat disagree	17 (4.5%)
		Disagree	30 (8%)
		Strongly disagree	22 (5.9%)
Q22	In what phase of COVID-19 recovery is your state?		n = 354
		1	26 (7.3%)
		2	124 (35%)
		3	110 (31.1%)
		4	45 (12.7%)
		5	2 (0.6%)
		6	1 (0.3%)
		Other	46 (13%)
Q23	Are staff worried about chronic effects of COVID-19?		n = 374
		Strongly agree	69 (18.4%)
		Agree	113 (30.2%)
		Somewhat agree	78 (20.9%)
		Other specified (0.5%)	
		My staff enjoys being on unemployment and will not return. I have sold my practice and am now retired.	1

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Section 2: COVID-19 pandemic-related questions

		Unsure	1	
Q24	Please rate the order of importance of the following protection measures against COVID-19.	<p>Neither agree nor disagree Somewhat disagree Disagree Strongly disagree Other</p> <p>N95 respirator face mask, hand wash, hand sanitizer Hand wash, hand sanitizer, N95 respirator face mask Hand sanitizer, N95 respirator face mask, hand wash Hand sanitizer, hand wash, N95 respirator face mask Hand wash, N95 respirator face mask, hand sanitizer N95 respirator face mask, hand sanitizer, hand wash</p>	<p>61 (16.3%) 14 (3.7%) 30 (8%) 7 (1.9%) 2 (0.5%) n = 369</p> <p>200 (54.2%) 74 (20.1%) 10 (2.7%) 5 (1.4%) 65 (17.6%) 15 (4.1%)</p>	

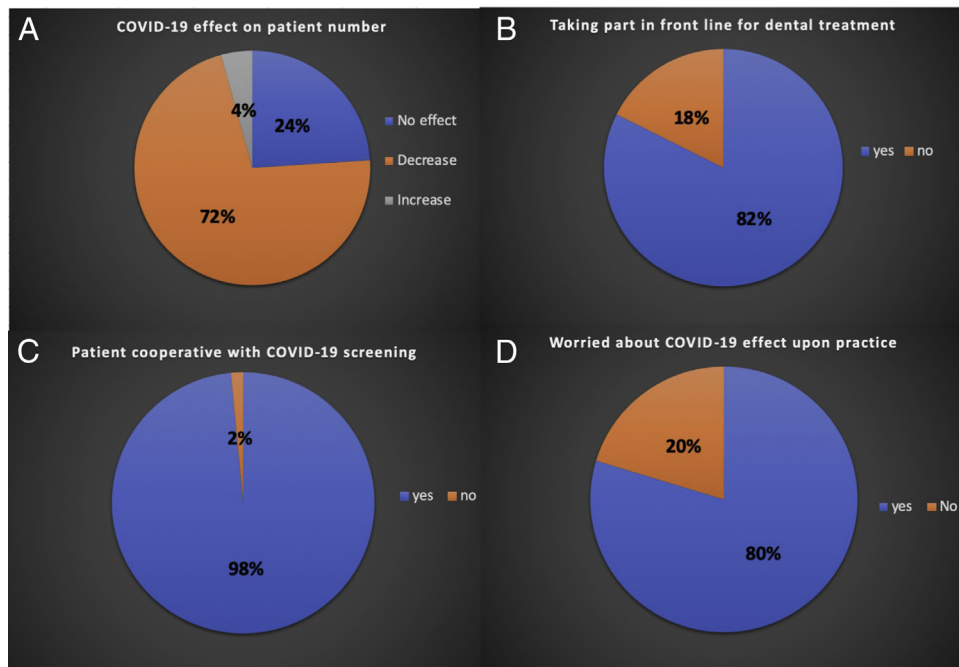
respondents agreed at some level that most of their staff worry about the chronic effects of COVID-19 (Table 1). The great majority of respondents ranked the order of most to least important protection measures against COVID-19 as an N95 mask, hand wash, and hand sanitizer (200/369, 54.2%) (Table 1). Our results indicated no significant differences in worries about COVID-19 infection related to gender, years of experience, type of practice, location, nature of the practice, and practicing district ( $P > .05$ ).

**DISCUSSION**

In this survey, endodontists who resumed their activities at some level as well as those who discontinued their practices shared that they were afraid of becoming infected, carrying infection from their dental practice to their families, staff becoming infected, as well as patient cross infection. Our results indicated no differences in worries about COVID-19 infection related to gender, years of experience, type of practice, location, nature of the practice, and practicing district ( $P > .05$ ). Psychological distress, including the fear of becoming infected while treating a patient or passing the infection on to family, is one of the most common fears shared among practitioners<sup>8-10</sup>. Recently, Tysiąc-Miśta and Dziedzic<sup>10</sup> reported a higher level of anxiety in those who suspended their clinical work than a dentist who continued their practice. The fear and anxiety are powerful emotions associated with the overwhelming reports on the COVID-19 pandemic by social, electronic, and print media.

From the endodontists who resumed their practice by July 2020, 72% of them reported that the number of patients decreased compared with the same time a year ago, whereas 24% of the endodontists said that the COVID-19 pandemic did not affect the number of patients attendance. In contrast, only 4% of the respondents reported an increase in the number of patients. Such variation may indirectly be due to the number of practitioners in operation at that time in their location. The reduction in the number of admitted patients is reported in the literature<sup>10</sup>.

The participants best described their patient COVID-19 screening techniques as taking patient body temperature, oral questions, and/or written questionnaires. During the COVID-19 pandemic, several screening questionnaires have been released by different dental associations and journals. Recently, Ather et al<sup>11</sup>



**FIGURE 1** – (A) Has the COVID-19 pandemic affected the number of patients in your practice when compared with the same time a year ago? (Question 10). (B) Are you taking part in endodontic care in front-line treatment of dental patients? (Question 11). (C) Are patients cooperative with added screening measures? (Question 15). (D) Are you worried about the effect of COVID-19 on your practice of endodontics? (Question 19).

published in the *Journal of Endodontics* a COVID-19 screening questionnaire with 6 short questions. The authors also emphasized to the endodontic community the need to measure the patient's body temperature by using a non-contact forehead thermometer or with cameras having infrared thermal sensors.

Although the diagnosis of COVID-19 relies on the detection of the SARS-CoV-2 RNA by real-time RT-PCR<sup>4,12,13</sup>, here only a few endodontists were using it as their patient screening technique. No endodontist participant requested chest x-ray for COVID-19 screening in their dental practice, although chest x-ray might show patchy shadows and ground-glass opacity in the lung<sup>14</sup>. It is worth pointing out that only a few participants reported uncooperative patients for the COVID-19 screening measurements adopted in their practice.

Patients with COVID-19 usually present with symptoms such as fever, cough, sore throat, fatigue, myalgia, headache, shortness of breath, and in some cases diarrhea<sup>11,15</sup>. Here most of the endodontists identified flu-like symptoms, body temperature higher than 100°F (38°C), loss of smell, shortness of breath, and being around someone diagnosed with COVID-19 as a positive response in their current patient screening techniques. The respondents also identified other findings such as travel history, sore throat, vomiting,

diarrhea, and stomach pain as a positive response in their current patient screening techniques. More recent studies have shown that the loss of taste (ageusia) or taste alteration (dysgeusia/amblygeusia) is common in COVID-19<sup>16</sup>. Indeed, the U.S. Centers for Disease Control and Prevention<sup>17</sup> include ageusia and dysgeusia as an early symptom of COVID-19. The salivary gland and tongue are potential targets for SARS-CoV-2 because of the expression of AC2<sup>18,19</sup>, but AC2 is also expressed in the gastrointestinal tract<sup>19</sup>, and individuals may present with diarrhea<sup>20</sup>.

Despite different screening techniques, 80% of positive patients have only mild symptoms that resemble flu-like symptoms and seasonal allergies. This might lead to an increased number of undiagnosed cases<sup>21</sup>. Of concern, these asymptomatic patients can act as "carriers" and also serve as a reservoir for re-emergence of the infection<sup>11</sup>.

Because of the high likelihood of SARS-CoV-2 transmission in the dental care setting, PPE is discussed in almost every COVID-19 survey-based research regarding dentists during COVID-19 pandemic. Here most of the endodontists described taking special measures beyond regular PPE. The use of the N95 respirator face mask was reported by 83.1% of the participants. The percentage of practitioners who enhanced PPE utilization

with the use of N95 respirator face mask varies across the surveys, ranging from 12%–90%<sup>11,22,23</sup>. The lack of adherence to the N95 respirator face mask may not only be explained as a lack of willingness to implement adequate procedures but also by the shortage of PPE announced in March 2020 by the WHO<sup>24</sup>. Some respondents also reported the use of other additional COVID-19 protection such as the face shield, head cover protective suit, as well as plexiglass aerosol shield for microscope and others.

According to our results, as of July 2020, most endodontists took part in endodontic care in the front-line treatment of dental patients (322/397, 82%). Most of the participants acknowledged trauma (326/397, 82.1%) followed by swelling (325/397, 81.9%), pain (302/397, 76.1%), and postoperative complication (237/397, 59.7%) to be emergencies. Thirty-five percent of the participants (139/397, 35%) reported all of the above emergencies. To help endodontists to assess a true emergency, Ather et al<sup>16</sup> provided a questionnaire for the assessment of true emergency. In addition, the authors put together a set of recommendations for the management of dental emergencies.

The majority of the respondents agreed at some level that the rubber dam is sufficient/efficient to reduce COVID-19 cross infection

from routine endodontic procedures. For instance, the rubber dam isolation can reduce airborne particles by up to 70% within a 3-foot diameter of the operational field<sup>25,26</sup>. The American Dental Association<sup>27</sup> recommends rubber dam isolation not only for endodontics procedures but for almost all aerosol-generating dental procedures. Because the virus load in human saliva is relatively high, preprocedural mouth rinses, despite their limited activity against SARS-CoV-2, the use of high volume saliva ejectors and oral aerosol vacuum, as well as air purifying unit, are recommended to reduce the hazard. Our survey indicated that 42.3% of the endodontists implemented an air purifying unit, and 16.9% added oral aerosol vacuum in their

practice beyond regular PPE and rubber dam isolation.

One of the limitations of this study is the number of respondents who participated in the survey. The small sample size may produce a clustering effect. Although participants were assured of their anonymity, concerns about being identified may have affected their answers<sup>28</sup>.

Overall, most endodontists are aware of the COVID-19 pandemic and are concerned about contracting and spreading the virus. Despite the conflict between their roles as health care providers and family members with the potential risk of exposing their families, most of them remain on duty providing front-line care for dental treatments.

In addition, this survey demonstrates endodontists' knowledge and awareness of the need for patient screening measures for COVID-19 and special measures beyond regular PPE equipment. It is important to point out that COVID-19 conditions can change rapidly, and endodontists must comply with the guidelines released by the WHO and dental associations.

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