

# Perceptions and Preparedness of Dental Professionals toward COVID-19-Related Oral Manifestations in India

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## Abstract

**Background:** With the reports of oral manifestations observed in coronavirus disease 2019 (COVID-19) patients snowballing day-by-day, it calls for the attention of dental professionals to keep themselves updated regarding these manifestations and how to prevent and manage them in COVID-infected patients. **Aims and Objectives:** The aim of this study is to assess the perceptions and preparedness of dental professionals in India toward the COVID-19-related oral manifestations. **Materials and Methods:** A cross-sectional, web-based survey was conducted on dental professionals using a pretested and validated questionnaire. Six hundred and twenty-three responses obtained from January 23, 2021 to February 15, 2021 were included in the study. **Results:** Mean knowledge scores regarding COVID-19-related oral manifestations were noted to be significantly high among males ( $13.5 \pm 4.9$ ), having a PhD ( $18.3 \pm 5.8$ ), belonging to the specialty of oral medicine and radiology ( $15.6 \pm 4.7$ ), with more than 15 years of clinical experience ( $15.4 \pm 4.7$ ) and practicing in metropolitan areas ( $13.7 \pm 5.03$ ). Tele-consultation and advising palliative care (65.5%) were the most preferred ways of managing COVID-19-related oral manifestations. Ninety-one percentage of the participants felt that inclusion of dentists in the intensive care unit multiprofessional teams, would contribute toward early diagnosis and management of oral manifestations. **Conclusion:** Study noted lower knowledge scores pertaining to COVID-19-related oral manifestations among BDS graduates with <5 years of clinical experience calling for the implementation of continuing dental education on the oral manifestations occurring in COVID-19 patients.

**Keywords:** Coronavirus disease 2019, coronavirus disease tongue, dental professionals, oral manifestations

## INTRODUCTION

As the pandemic hit the world, it immensely shook everyone's lives affecting almost every sector including and mainly healthcare. Oblivious to what has befallen, researchers across the world delved into the whys and wherefores of the pandemic. Intriguingly, the research published in recent times disclosed the occurrence of oral manifestations in coronavirus disease 2019 (COVID-19)-infected patients. Chaux-Bodard *et al.*<sup>[1]</sup> has first published a case of tongue ulceration noticed in a 45-year-old COVID patient. Zarch and Hosseinzadeh<sup>[2]</sup> found dry mouth as a common oral manifestation of COVID-19 followed by dysgeusia and candidiasis after reviewing 170 cases in 17 studies. Favia *et al.*<sup>[3]</sup> has categorized the oral lesions seen in COVID-19 patients into four groups based on features of the lesions, timing of their occurrence, and the treatments administered: (a) Probably, preexisting conditions (b) severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2)-related lesions

(c) Treatment-related lesions (d) Lesions related to poor oral hygiene.

The possible mechanisms for the occurrence of these oral manifestations in COVID patients are still ambiguous. Nonetheless, the oral cavity could be a potential target organ of SARS-CoV-2 owing to the expression of angiotensin-converting enzyme 2 and furin in oral tissues, which play a pivotal role in SARS-CoV-2 invasion of host cells.<sup>[4]</sup> Hence, it is essential for oral health care providers to be aware of how COVID-19 and its treatments affect oral health. In this context, the present study

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aimed to assess the perceptions and preparedness of dental professionals toward COVID-19-related oral manifestations.

## MATERIALS AND METHODS

### Study design and population

A cross-sectional web-based study was conducted using an online questionnaire to assess the perceptions of dental professionals including dentists, postgraduates, and interns in India regarding the oral manifestations reported among COVID-19 patients and their preparedness to prevent and manage them. The dental professionals who were involved in patient care during the COVID pandemic were included in the study. The study was carried out from January 23, 2021 to February 15, 2021.

### Questionnaire development and pretesting

Following an electronic search of the databases for the literature published on the impact of COVID-19 and its treatment on the oral cavity and the oral manifestations that were reported in COVID-19 patients, a preliminary questionnaire was constructed under three sections:

- Demographic data
- Perceptions toward COVID-19-related oral manifestations
- Preparedness toward COVID-19-related oral manifestations.

The questionnaire was reviewed for clarity, face, and content validity by a panel of experts, followed by pilot testing on participants. It was further evaluated for internal consistency reliability (Cronbach's alpha – 0.82) and test-retest reliability among 40 participants (Intraclass correlation coefficients – 0.92). The questionnaire contained 5 knowledge-related questions with multiple correct responses and a score of 1 was given for each correct response, which accounted to a maximum possible knowledge score of 29.

### Sample size

Sample size was calculated using G\*Power 3.1.9.2 software (University of Dusseldorf, Germany). Based on the observations by Arora *et al.*<sup>[5]</sup> on the knowledge and preparedness of Indian dentists during COVID-19 pandemic, a sample size of 400 was deemed sufficient at an alpha level of 5% and power of 80%. The formula used for sample size calculations was  $Z\alpha 2pq/d2$ .

### Data collection

The revised questionnaire prepared using Google forms was shared through E-mail and Whatsapp to the dental health care professionals through convenience and snowball sampling. Participants were informed that their participation in the study will be anonymous and will be considered their consent to participate and publish the data provided by them. In fulfillment of the key considerations proposed by Wicher and Wu<sup>[6]</sup> for determining the need for an ethics oversight for survey research, the present study excluded participants who are vulnerable or with diminished autonomy, and there was no greater than minimal informational or psychological

harms present to the participants. Hence an ethical clearance was deemed not to be necessary from an Institutional Review Board. A total of 623 responses obtained during the study period were included in the study.

### Statistical analysis

The data were compiled into Microsoft excel sheet and subjected to statistical analysis using the Statistical Package for the Social Sciences-20.0 (IBM SPSS, Armonk, NY, USA). The statistical tests used to analyze the data were Chi-square test, Kruskal–Wallis ANOVA, and Mann–Whitney *U*-test.

## RESULTS

### Background characteristics of the participants

Among the 623 dental professionals who had participated in this study, 342 (54.9%) were females. The mean age of the participants was  $32.03 \pm 10.83$  years. Slightly more than half of the study participants were working in urban areas (51.7%) and only 18.6% had clinical experience of more than 15 years [Table 1].

### Participants' perceptions toward coronavirus disease 2019-related oral manifestations

Nearly, half of the respondents (46.1%) had either screened or treated COVID-19 infected or recovered patients for oral health problems. However, only 17.3% of the study participants reported coming across COVID-19 diagnosed or recovered patients presenting with oral manifestations. Among the participants, males and those having a PhD with more than 15 years of clinical experience belonging to the specialties oral surgery and orthodontics reported significantly ( $P < 0.05$ ) higher experience in treating or screening for oral health problems and noticing oral manifestations in COVID-19 patients [Table 1]. Osteomyelitis, ulcerations, and candidiasis were the most reported oral manifestations that were noticed by the study participants in COVID-19 patients [Table 2]. Nearly, 80% held the notion that oral tissues are one of the target organs in COVID-19 infection, and agreed that COVID-19-infected patients might present oral manifestations along with systemic features. Less than 40% of the study participants were aware of the term “*COVID tongue*.”

### Participants' knowledge toward coronavirus disease 2019-related oral manifestations

Among the COVID-19-related oral manifestations reported in the published literature, alteration or loss of taste sensation (66%), ulcerations and blisters (59.6%), and opportunistic infections (58.4%) were the most known manifestations to the participants, whereas, melanin hyperpigmentation (4.8%), fixed drug eruptions (8%), and petechiae (8.2%) were the least known. About 80% of the participants believed that COVID-19-infected patients with underlying systemic diseases were most susceptible to develop oral manifestations. About 76.7% opined that the oral manifestations develop secondary to deterioration of systemic health in COVID affected patients and opted underlying

**Table 1: Correlation of participants background characteristics with their experience of providing oral health care for and noticing oral manifestations among coronavirus disease 2019 infected/treated participants (n=623)**

Variable	Category (n)	Question 1		Question 2	
		Yes, n (%)	P	Yes, n (%)	P
Gender	Male (281)	190 (67.6)	<0.001*	67 (23.8)	<0.001*
	Female (342)	97 (28.4)		41 (12)	
Specialty	None (BDS) (228)	51 (22.9)	<0.001*	32 (13.7)	<0.001*
	Oral surgery (47)	42 (89.3)		19 (40.4)	
	Endodontics (61)	41 (67.2)		11 (18)	
	Orthodontics (33)	26 (78.8)		11 (33.3)	
	Prosthodontics (37)	26 (70.3)		10 (27)	
	Periodontics (113)	49 (43.4)		15 (13.3)	
	Pedodontics (49)	19 (38.8)		5 (10.2)	
	Public health dentistry (30)	14 (46.7)		2 (6.7)	
	Oral medicine and radiology (16)	12 (75)		1 (6.2)	
	Oral pathology (9)	7 (77.8)		2 (22.2)	
	Clinical experience (years)	<5 (346)		96 (27.7)	
5-10 (86)		42 (48.8)	10 (11.6)		
11-15 (75)		55 (73.3)	28 (37.3)		
>15 (116)		94 (81)	21 (18.1)		
Location of workplace	Metropolitan (159)	93 (58.5)	0.092	21 (13.2)	0.001*
	Rural (322)	132 (41)		66 (20.5)	
	Urban (142)	62 (43.7)		21 (14.8)	

Chi-square test;  $P \leq 0.05$  considered statistically significant; \*Statistical significance. Question 1: Have you had the experience of treating or screening participants who are diagnosed/treated for COVID-19?, Question 2: Have you seen participants who are diagnosed/treated for COVID-19 presenting with oral manifestations?, COVID-19: Coronavirus disease 2019

**Table 2: Oral manifestations observed and the respective treatments provided to the coronavirus disease 2019 diagnosed/recovered patients as reported by the study participants**

Oral manifestations in COVID-19 diagnosed/recovered patients	Treatments provided
Osteomyelitis (n=27)	Surgical debridement; resection; medication
Ulcerations (n=24)	Multivitamin supplements; topical analgesic gels
Candidiasis (n=9)	Antifungals
Tooth mobility (n=6)	Scaling and root planing followed by splinting; extraction
Gingival bleeding (n=5)	Prescribed chlorhexidine mouthwash. Oral hygiene instructions given. Scaling and root planing performed after patient tested COVID negative
Mucormycosis (n=4)	Resection and obturator placement
Severe bone loss (n=2)	Flap surgery
Multiple abscesses/sinus openings (n=2)	Antibiotics
Bruxism (n=1)	Night guard
Xerostomia (n=7)	Not specified
Gingival enlargement (3)	Not specified
Loss of taste and smell (n=2)	Not specified
Others* (5)	Not specified

\*Aphthous stomatitis with burning sensation, tonsillitis and redness of tongue, halitosis, periodontitis, dry socket (1 each). n: Number of cases reported for each oral manifestation noticed by the participants, COVID-19: Coronavirus disease 2019

systemic diseases (69.3%) and poor oral hygiene (61.2%) as the predisposing factors. About 80.3% chose steroids and 52.3% chose antivirals as the drugs used for COVID-19 treatment which are more likely to cause COVID-19-related oral manifestations when used for longer duration [Table 3].

Upon comparison of background characteristics, male oral health care professionals ( $13.5 \pm 4.9$ ), having a PhD ( $18.3 \pm 5.8$ ), belonging to the specialty of oral medicine and radiology ( $15.6 \pm 4.7$ ), with more than 15 years of clinical

experience ( $15.4 \pm 4.7$ ), and practicing in metropolitan areas ( $13.7 \pm 5.03$ ) demonstrated significantly higher mean knowledge scores ( $P < 0.05$ ) [Table 4].

Specialists in oral and maxillofacial surgery, oral medicine, and radiology showed significantly higher mean scores compared to those with no specialization after adjusting for variables such as gender, highest level of education, years of clinical experience, and location of work. Similarly, study participants with more than 10 years of clinical experience had higher mean

**Table 3: Participants' knowledge toward coronavirus disease 2019-related oral manifestations (n=623)**

Knowledge associated questions concerning COVID-19-related oral manifestations:	n (%)
COVID-19 patients who are most susceptible to develop oral manifestations:	
Asymptomatic patients	92 (14.8)
Long haulers (✓)	213 (34.2)
COVID-19 infected patients with underlying systemic diseases (✓)	497 (79.8)
Patients with severe COVID-19 infection requiring hospitalization (✓)	307 (49.3)
Oral manifestations that can be seen in covid-19 patients: (all the options were correct responses)	
Opportunistic infections	364 (58.4)
Ulcerations and blisters	371 (59.6)
Desquamative gingivitis	103 (16.5)
Fixed drug eruptions	50 (8)
Xerostomia	191 (30.7)
Gingivitis	160 (25.7)
Melanin hyperpigmentation	30 (4.8)
Altered/loss of taste	411 (66)
Recurrent oral HSV infections	80 (12.8)
Petechiae	51 (8.2)
Tooth loss	64 (10.3)
Necrotizing disease	158 (25.4)
Burning sensation	168 (27)
Tongue depapillation	211 (33.9)
Osteomyelitis	216 (34.7)
Occurrence of COVID-19-related oral manifestations is: (all the options were correct responses)	
Due to COVID-19 infection	272 (43.7)
Secondary to the deterioration of systemic health	478 (76.7)
Due to treatments for COVID-19	356 (57.1)
Predisposing factors for COVID-19-related oral manifestations: (all the options were correct responses)	
Poor oral hygiene	381 (61.2)
Trauma secondary to intubation	100 (16.1)
Underlying systemic diseases	432 (69.3)
Stress	315 (50.6)
Old age	275 (44.1)
Hyperinflammatory response secondary to COVID-19 infection	360 (57.8)
Drugs used for treatment of COVID-19 which are more likely to cause COVID-19-related oral manifestations when used for longer duration:	
Anti-viral (✓)	326 (52.3)
Anticoagulants	50 (8)
Steroids (✓)	500 (80.3)
Antimalarial	52 (8.3)
Supplements	58 (9.3)

COVID-19: Coronavirus disease 2019, HSV: Herpes simplex virus

knowledge scores compared to those with <5 years of clinical experience [Table 5].

### Preparedness of the participants toward coronavirus disease 2019-related oral manifestations

Teleconsultation and advising palliative care based on the oral manifestations present (65.5%) was found to be the most preferred way of managing oral manifestations in COVID-19 patients by the study participants. More than 92% of oral health care professionals participated in this study opined that dental check-ups are necessary for COVID-19 affected participants on long-term steroid therapy in light of their vulnerability for opportunistic infections. Eighty-seven percentage agreed that COVID-19 patients on

long-term steroid therapy with preexisting systemic diseases require prophylactic antibiotics and antifungals to prevent the emergence of secondary infections. Furthermore, 91% held the notion that inclusion of dentists in the intensive care unit (ICU) multiprofessional teams would contribute toward early diagnosis and management of oral manifestations in COVID-19 patients.

### DISCUSSION

The novel coronavirus disease was found to impact oral health with about 45% of the COVID-19-infected patients presenting with oral manifestations.<sup>[7]</sup> In the present study, almost 80% of the participants agreed that COVID-19 patients

**Table 4: Mean knowledge scores and differences based on the background characteristics of the participants (n=623)**

Variable	Category	Mean±SD	P
Gender	Male	13.55±4.97	0.001**
	Female	10.49±4.27	
Specialty	None (BDS)	10.5±4.39	<0.001*
	Oral surgery	14.19±5.09	
	Endodontics	12.7±4.84	
	Orthodontics	15.03±3.19	
	Prosthodontics	13.59±4.27	
	Periodontics	11.15±5.34	
	Pedodontics	11.67±3.87	
	Public health dentistry	12.27±5.14	
	Oral medicine and radiology	15.63±4.71	
	Oral pathology	12±4.61	
Years of clinical experience	<5	10.67±4.35	<0.001*
	5-10	10.24±4.22	
	11-15	13.71±4.43	
	>15	15.48±4.74	
Location of workplace	Metropolitan	13.77±5.03	<0.001*
	Urban	11.18±4.72	
	Rural	11.31±4.36	

Kruskal-Wallis ANOVA; \*Mann-Whitney U-test; P≤0.05 considered statistically significant; \*Statistical significance. SD: Standard deviation

**Table 5: Multiple linear regression model showing characteristics significantly related to knowledge scores regarding coronavirus disease 2019-related oral manifestations (n=623)**

Characteristic	β	SE	t	P
Gender (Reference:Female)				
Gender (male)	0.887	0.465	1.908	0.057
Specialty (Reference:BDS)				
Oral and maxillofacial surgery	1.595	0.758	2.105	0.036*
Endodontics	-0.06	0.7	-0.094	0.925
Orthodontics	1.014	0.939	1.081	0.28
Prosthodontics	1.273	0.827	1.541	0.124
Periodontics	0.09	0.561	0.161	0.872
Pedodontics	-0.311	0.745	-0.417	0.676
Public health dentistry	0.167	0.89	0.188	0.851
Oral medicine and radiology	3.193	1.202	2.656	0.008*
Oral pathology	0.813	1.537	0.529	0.597
Clinical experience (Reference: <5 years)				
5-10	-1.11	0.601	-1.862	0.063
11-15	1.99	0.69	2.886	0.004*
>15	3.034	0.652	4.653	0.001*
Location (Reference: Metropolitan)				
Urban	-1.341	0.461	-2.91	0.004*
Rural	-1.697	0.531	-3.19	0.001*
Intercept	10.675	0.724	14.734	0.001*

R=0.429; R<sup>2</sup>=0.184; Adjusted R<sup>2</sup>=0.166; P≤0.05 considered statistically significant; \*Statistical significance. SE: Standard error

might present oral manifestations and believed that oral tissues are one of the target organs in COVID-19 infection. Less

than 20% of the study participants reported coming across COVID-19 diagnosed or recovered participants presenting with oral manifestations. This could be due to missed diagnosis and reporting of the cases rather than less incidence of the cases alone. The mean knowledge scores concerning COVID-19-related oral manifestations was relatively high among participants having a PhD, with more than 10 years of clinical experience compared to BDS graduates with clinical experience of <5 years which could be attributed to their limited exposure to the current research data regarding the disease processes and manifestations.

Our study found that among the various COVID-19-related oral manifestations, alteration or loss of taste sensation (66%), ulcerations and blisters (59.6%), and opportunistic infections (58.4%) were known to the majority of the participants. This is in accordance with the occurrence of the findings reported by Santos *et al.*,<sup>[8]</sup> where they stated gustatory disorders as most commonly noticed manifestations followed by oral mucosal lesions.

More than half of the participants believed that the occurrence of COVID-19-related oral manifestations is secondary to deterioration of systemic health and due to treatments used for COVID-19, mostly due to long-term usage of steroids and anti-virals. Brandini *et al.*<sup>[9]</sup> suggested possible etiologies for the occurrence of these oral lesions:

- Direct or indirect interaction of SARS-CoV-2 with oral cells resulting in disruption of tissue integrity,
- Adverse reactions of the drugs used for COVID treatment triggering lesions of herpes simplex virus, candida, xerostomia, nonspecific ulcerations, and gingivitis and
- Hyperinflammatory, as well as immunosuppressive conditions induced due to COVID infection might cause viral reactivation and promote the growth of opportunistic organisms.

More than half of the study participants believed underlying systemic diseases, poor oral hygiene, hyperinflammatory response secondary to COVID-19 infection, and stress as the predisposing factors for the oral manifestations seen in COVID patients. On similar note, Fidan *et al.*<sup>[10]</sup> supposed that these lesions were a consequence of various factors including poor oral hygiene, stress, and systemic infections. Viral invasion and dysbiosis induced by the use of therapeutic drugs might also be involved in the occurrence of oral lesions in COVID-19 patients.<sup>[11]</sup> Among the various drugs used for the treatment of COVID-19, when used for longer duration, steroids were known to cause opportunistic infections and anti-virals can lead to dry mouth, taste disturbances, ulcerations, erythema multiforme, and parotid lipomatosis.<sup>[12,13]</sup>

The infectious nature of this novel disease makes it challenging to adhere with the routine oral disease diagnosing and managing strategies. The study participants preferred the use of teleconsultation and advice palliative care based on the oral manifestations present. Guo *et al.*<sup>[14]</sup> proposed that acute oral mucosal lesions treatments were based on the type of the lesion

seen and advised the use of systemic antibacterials, antivirals, antihistamines, immunosuppressants, and low-to-medium doses of glucocorticoids as required with topical adjuncts such as anti-inflammatory gargle and ointment, chlorhexidine and povidone-iodine solution, and topical glucocorticoid preparations, to ease the pain and promote healing of lesions. They also advised the use of web-based consultations and lesion photographs to aid in the diagnosis of oral-mucosal lesions, especially for patients with active COVID infection.

The majority of participants as preventive strategies, reckoned that dental check-ups are necessary for COVID-19 patients who were on long-term steroid therapy and believed that these patients might require prophylactic antibiotics and antifungals to prevent the emergence of secondary infections, especially those with systemic comorbidities. Santos *et al.*<sup>[15]</sup> stated that dental follow-ups are necessary for the COVID patients following dismissal from the hospital. They also highlighted the role of dentists in maintaining the oral health of the ICU-admitted COVID-19 affected patients. In agreement with this, 91% of the participants deemed that inclusion of dentists in the ICU multiprofessional teams would contribute toward early diagnosis and management of oral manifestations in COVID-19 patients.

## CONCLUSION

The myriad of oral manifestations occurring in COVID patients appears to be multifactorial in origin with varying severity. Although the majority of the reported cases are not fatal, certain conditions such as osteomyelitis and necrotic diseases can wreak havoc, if left untreated and needs to be diagnosed at the earliest. Dental professionals should scrutinize for the presence of oral lesions while treating patients who were infected and treated for COVID-19 to provide oral care and improve patient's quality of life. It is also imperative to develop guidelines for diagnosing and managing the COVID-19-related oral manifestations.

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## Conflicts of interest

There are no conflicts of interest.

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