

Research Article

Exploring Dentists' Awareness and Approaches to Mucormycosis: A Post-COVID Orofacial Complication in the Context of Communicable Diseases

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A B S T R A C T

Introduction: COVID-19 has increased opportunistic infections like mucormycosis, especially in immunocompromised individuals. Dentists play a key role in early detection and management of post-COVID oral complications, yet their awareness of mucormycosis remains underexplored.

Objective: This study assesses dentists' knowledge, attitudes, and practices regarding mucormycosis as a post-COVID orofacial complication.

Methods: A cross-sectional study analyzed dentists' demographics, awareness, and clinical practices on post-COVID mucormycosis. Data were statistically analyzed using SPSS 21.0.

Results: Among participants, 81.6% had a fair understanding of post-COVID fungal infections, and 99.2% correctly identified mucormycosis. However, only 77.6% knew its diagnostic criteria. While 87% recognized mucormycosis as a complication, 72.8% identified rhino-orbital-cerebral mucormycosis as the most common type. Additionally, 73% were aware of treatment protocols, but only 17.8% had screened patients in the past year.

Conclusion: Although dentists show strong awareness, gaps exist in clinical preparedness and diagnostic accuracy. Targeted training can enhance early detection, intervention, and multidisciplinary collaboration for better patient outcomes.

Keywords: Mucormycosis, Post-COVID-19 Complications, Orofacial Manifestations, Dentists' Awareness, Fungal Infections

Introduction

The coronavirus disease (COVID-19) was first identified in Wuhan, China, in December 2019 and rapidly spread across multiple countries.¹ In March 2020, the World Health Organization professed it as a pandemic. The disease primarily affects the respiratory system and has posed a global health emergency. Its severity ranges from mild symptoms resembling the common cold to severe pneumonia, which can be life-threatening.

The primary mode of COVID-19 transmission is through respiratory droplets from person to person, direct contact, and contact with contaminated surfaces. The prognosis is poorer in individuals with underlying health conditions such as hypertension, diabetes mellitus, cardiovascular diseases, chronic kidney failure, and chronic respiratory diseases.

Dry eyes, oral mucosal dryness, vesiculobullous and aphthous-like lesions in the oral mucosa, along with loss of taste and smell, have been the most commonly reported oral and para-oral complaints in treated COVID-19 patients.²

Furthermore, an increasing number of cases of mucormycosis have been stated and diagnosed in treated COVID-19 patients in the post-pandemic period. Mucormycosis (previously known as zygomycosis), commonly known as black fungus, is a rare but serious fungal infection caused by mucormycetes moulds. (or zygomycetes). This infection primarily affects immunocompromised individuals and can present in various forms, including rhino-orbital, pulmonary, cutaneous, disseminated, or gastrointestinal variants. However, the rhino-cerebral-orbital type is the most commonly reported form of mucormycosis. It is associated with high mortality. Imaging techniques are not typically diagnostic, and even cultures may be unreliable. A definitive diagnosis is established through histological examination. Despite aggressive medical and surgical management, treatment alone is often insufficient, leading to disease progression and increased risk of mortality.³

The common clinical manifestations of mucormycosis include a running nose, pain, unilateral facial swelling, headache, blurred vision, fever, bulging or displacement of the eye (proptosis), and, in severe cases, necrosis of cells and tissues.⁴

The clinical significance of mucormycosis lies in its invasive and rapidly progressing nature, making early diagnosis and prompt intervention crucial for effective treatment.⁵ Management of mucormycosis involves surgical debridement combined with systemic antifungal therapy, while prosthetic rehabilitation may later be required to restore surgical defects.⁶

Understanding dentists' awareness of post-COVID-19 manifestations and the importance of early diagnosis of conditions like mucormycosis is crucial. Raising awareness

can help prevent severe morbidity and potential mortality while also identifying possible risk factors, predicting outcomes, and guiding future treatment strategies.

The current study was designed to assess dentists' awareness of mucormycosis and other potential oral findings of COVID-19 in the post-pandemic period, along with associated complications.

Materials and Methods

Study Strategy

In this cross-sectional study, a validated questionnaire was used to assess dentists' awareness of the oral manifestations of post-COVID-19. All participants provided informed consent, and ethical approval was secured from the institutional review board and ethics committee (No: IEC/01-25-2023). The questionnaire was well-structured and comprised a total of 17 closed-ended questions. The questionnaire was designed to assess the demographic profile, as well as the knowledge, attitudes, and practices related to the oral manifestations of post-COVID-19. The demographic section included details on participants' academic qualifications, gender, and sources of information regarding COVID-19 infection.

Study Participants

This study was conducted among dentists practising in various parts of India who were accessible through social media and online platforms.

Statistical Evaluation

Statistical evaluation was performed using the Statistical Package for the Social Sciences (SPSS) version 21.0 (IBM, Chicago, IL, USA). Statistical evaluation was used to summarise the data. Mean and standard deviation were used to represent continuous variables, while categorical data were expressed in percentages. Statistical analysis was performed using the chi-square test and Pearson's correlation coefficient.

Results

A total of 500 dentists took part in this study. The participants' demographic profile is outlined in Table 1. Of the 500 participants, 113 were male, while 387 were female. Regarding academic qualifications, the majority of participants were postgraduates (67.8%). In terms of sources of information about COVID-19, the Internet was cited as the primary source by 51.2% of participants, followed closely by social media platforms (38.4%) (Table 1).

Regarding awareness of potential fungal infections in post-COVID-19 patients, 81.6% of participants reported having a fair understanding of such infections. Additionally, 99.2% correctly identified black fungus as another common name for mucormycosis.

However, a concerning finding was that only 77.6% of participants were well-versed in the diagnostic criteria for mucormycosis (Table 2).

When assessing attitudes toward oral manifestations in post-COVID-19 patients, 73.2% of participants expressed confidence in their knowledge, whereas 26.8% admitted to having no clear understanding—an area of concern.

Furthermore, 87% of participants recognised mucormycosis as a potential sequela of post-COVID-19, and 95.6% acknowledged that it is a life-threatening and invasive fungal infection. Additionally, 98.8% were familiar with its clinical features and affected areas. However, only 72.8% correctly identified rhino-orbital-cerebral mucormycosis as the most common type, and an equal proportion of participants (73%) were aware of the standard treatment protocols for the disease (Table 2).

Regarding clinical experience, only 17.8% of participants reported screening patients for mucormycosis in the past 12 months, and 73% had referred patients to higher centres for prosthetic rehabilitation of post-surgical defects caused by the infection (Table 2).

Table 1. Demographic Profile of Participants

N = 500

Variable	n (%)
Gender	
Male	113 (22.6)
Female	387 (77.4)
Academic qualification	
Undergraduate (BDS)	161 (32.2)
Postgraduate (MDS)	339 (67.8)
Source of COVID-19 information	
Internet	256 (51.2)
Social media	192 (38.4)
Scientific journals	29 (5.8)
Government guidelines	23 (4.6)

Table 2. Evaluation of Participants' Knowledge, Perspectives, and Practices Regarding COVID-19-Related Mucormycosis

N = 500

Variables	No n (%)	Not Sure n (%)	Yes n (%)
Knowledge factors			
Are you aware that fungal infections may develop in post-COVID-19 patients?	92 (18.4)	0 (0.0)	408 (81.6)
Do you know the other names of mucormycosis?	4 (0.8)	0 (0.0)	496 (99.2)
Do you understand the diagnostic criteria for mucormycosis?	90 (18.0)	22 (4.4)	388 (77.6)
Attitude factors			
Are you aware of potential oral manifestations of post-COVID-19 patients?	134 (26.8)	0 (0.0)	366 (73.2)
Do you know that mucormycosis can occur as a complication of post-COVID-19 oral conditions?	65 (13.0)	0 (0.0)	435 (87.0)
Are you aware that mucormycosis is a severe, invasive, and life-threatening fungal infection?	22 (4.4)	0 (0.0)	478 (95.6)
Do you have knowledge of different types of mucormycosis?	6 (1.2)	0 (0.0)	494 (98.8)
Are you aware that the most prevalent form of mucormycosis is rhino-orbital cerebral mucormycosis?	90 (18.0)	46 (9.2)	364 (72.8)
Can you recognise the clinical symptoms of mucormycosis?	22 (4.4)	2 (0.4)	476 (95.2)
Do you understand the treatment approach for mucormycosis?	114 (22.8)	21 (4.2)	365 (73.0)

Are you aware of the primary antifungal drug used in mucormycosis treatment?	114 (22.8)	80 (16.0)	306 (61.2)
Do you know the role of oral and maxillofacial surgeons in mucormycosis care?	22 (4.4)	66 (13.2)	412 (82.4)
Practice factors			
Have you diagnosed or treated mucormycosis patients in the past 12 months?	385 (77.0)	26 (5.2)	89 (17.8)
Would you refer a patient for prosthetic rehabilitation after mucormycosis-related surgery?	50 (10.0)	85 (17.0)	365 (73.0)

Discussion

The present study provides insights into dentists' awareness of the potential oral manifestations and complications associated with post-COVID-19. The questionnaire used in this study was developed based on a review of the literature on orofacial complications observed in the post-pandemic period.

In this study, approximately two-thirds of the participants demonstrated awareness of the possible oral and orofacial manifestations linked to post-COVID-19. These included various clinical presentations affecting the tongue, xerostomia, salivary gland diseases, different fungal infections, superficial and deep ulcerations, and herpetic infections.

The findings suggest that dentists are well-equipped to assess and manage recovered COVID-19 patients for potential oral complications. Their approach reflects a realistic and comprehensive strategy for patient support and management.

In addition, in the current study, most of the participants (81.6%) reported having a fair understanding of the possible fungal infections that may occur in treated COVID-19 patients. Additionally, 99.2% of participants were familiar with the more common name for mucormycosis.

However, a concerning finding was that only 77.6% of participants were well-versed in the diagnostic criteria for mucormycosis. The use of immunosuppressive drugs for various conditions, along with underlying comorbidities, significantly increases the risk of fungal infections in immunocompromised patients. A major cause for concern in such cases is the aggressive clinical presentation of these fungal infections, often associated with extensive tissue necrosis, ulceration, and involvement of underlying connective tissues, including bone.

The most commonly diagnosed fungal infections in immunocompromised patients and those with comorbidities include oral candidiasis, aspergillosis,

cryptococcosis, histoplasmosis, blastomycosis, and geotrichosis. Additionally, there has been a rising number of mucormycosis cases in treated COVID-19 patients. Research by White et al. screened 135 adults with post-COVID-19 illness and reported an incidence of 26.7% for mucormycosis, 14.1% for aspergillosis, and 12.6% for candidiasis, in descending order.⁷

Further analysis in the present study revealed that only 73.2% of participants felt confident in identifying the various oral manifestations seen in treated COVID-19 patients, while 26.8% lacked clear information on the subject. Additionally, 87% of participants acknowledged mucormycosis as a sequela of post-COVID-19, and 95.6% were aware that mucormycosis is a life-threatening invasive fungal infection. These findings indicate that the participants had a strong understanding of the potential occurrence and severity of mucormycosis in post-COVID-19 cases.

Mucormycosis is a rare but serious fungal infection classified as fulminant fungal sinusitis, primarily affecting immunocompromised individuals. The global fatality rate for mucormycosis has been estimated at 46%. Although diagnosing the disease is challenging, early detection and treatment are crucial in preventing severe morbidity.⁸ Several types of mucormycosis have been reported in the literature, including rhino-orbital-cerebral, pulmonary, gastrointestinal, and disseminated mucormycosis.⁴

In the present study, 98.8% of participants were aware of the different types of mucormycosis, while 95.2% recognised its clinical features. However, satisfactory responses were not obtained when participants were asked for more detailed information. Only 72.8% knew that rhino-orbital-cerebral mucormycosis is the utmost common form, and an equal percentage were familiar with the treatment protocol.

The clinical features of rhino-orbital-cerebral mucormycosis include facial pain, paraesthesia, headache, blackish discolouration of the nasal and palatal mucosa, proptosis, nasal and periorbital oedema, inflammation, eyelid drooping, external and internal ophthalmoplegia, and

sudden vision loss. The infection primarily develops in the nasal and oral mucosa and then progresses to the paranasal sinuses. Sudden vision loss occurs due to the involvement of the optic nerve or blood vessels supplying the retina. The infection can also extend to intracranial spaces either through direct spread from the orbital surfaces and sinus walls or via the bloodstream.⁹

A better prognosis in mucormycosis cases depends on early diagnosis, controlling predisposing risk factors, extensive removal of necrotic tissue, and proper systemic antifungal therapy. The drugs of choice are systemic amphotericin B and its liposomal derivatives, which significantly boost survival rates.¹⁰ Regular debridement of necrotic tissue from the paranasal sinuses is essential to prevent further spread of the infection into cranial spaces. Additionally, irrigation of the affected areas with diluted amphotericin B is prescribed to slow disease progression and mitigate complications.

Managing mucormycosis requires a multidisciplinary approach, involving microbiologists, internal medicine specialists, intensivists, neurologists, ENT surgeons, ophthalmologists, oral and maxillofacial surgeons, and prosthodontists.^{11,12} In this study, 82.4% of participants acknowledged the role of oral and maxillofacial surgeons in the surgical debridement of mucormycosis, while only 73% had referred patients to prosthodontists for prosthetic rehabilitation of post-surgical defects. This highlights a significant gap in post-surgical rehabilitation, which could lead to permanent morbidity.

Surgical reconstruction is often the preferred approach for managing defects in treated mucormycosis patients. However, prosthetic rehabilitation offers several advantages, including the ability to cover larger defects, predictable cosmetic outcomes, easier detection and management of recurrences, and suitability for elderly patients who may not tolerate multiple surgeries.¹³

Another prominent finding of this study was that only 17.8% of participants had screened mucormycosis patients in the past 12 months. This may indicate underreporting due to a lack of awareness or the fact that most cases were managed in medical centres rather than dental facilities. Furthermore, many dental facilities remained closed during the lockdown period. This observation matches the conclusions of a study by Wang et al. in China, which reported a substantial decrease in dental visits due to challenges in emergency dental care and public health restrictions.¹⁴

Conclusion

Within the constraints of this research, it is concluded that dentists demonstrated a strong awareness of the possible oral manifestations of COVID-19, including mucormycosis. However, there remains a need to further enhance their

understanding of the multidisciplinary approach required for managing deep fungal infections like mucormycosis, which has increasingly become a significant concern in treated COVID-19 patients during the post-COVID phase.

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