



**PARADIGM SHIFT IN ENDODONTIC FRAMEWORK AS AN AFTERMATH OF
COVID-19 IN 2021**

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Article Received on 09/08/2021

Article Revised on 30/08/2021

Article Accepted on 20/09/2021

ABSTRACT

Despite global efforts to contain the disease spread, the outbreak of Covid-19 is still on a rise because of the community spread pattern of this infection. Dental professionals, including endodontists, may encounter patients with suspected or confirmed SARS-CoV-2 infection and will have to act diligently not only to provide care but also to prevent nosocomial spread of infection. The importance of infection control is therefore crucial in limiting the effects of virus diffusion. Due to the rapidly evolving situation, further assessment of the implications of COVID-19 outbreak in dental practice is needed. Thus, the aim of this article is to provide awareness about the pandemic and opportunistic fungal infections as no specific therapies are available, therefore, early containment and prevention of further spread will be crucial to stop the ongoing outbreak and to control this novel infectious thread.

KEYWORDS: SARS-CoV-2; Pandemic; Endodontics; Mucormycosis; Transmission.

INTRODUCTION

The novel coronavirus is the member of Coronaviridae family.^[1] It is a single-stranded RNA virus that includes a range of respiratory viruses presenting with mild to severe manifestations and eventually leading to respiratory failure. It is named corresponding to its microscopic appearance, characterized by the presence of pointed structures on the surface, resembling a crown.^[2]

Earlier, declaration of anosmia was a typical symptom marker for the detection of virus. Now, another potentially deadly symptom of invasive fungal sinusitis resulting from mucormycosis has been observed.

Mucormycosis invasion of the sinuses is a life-threatening fungal infection that typically affects immune-compromised individuals with an impaired neutrophilic response and systemic disorders characterised by the presence of hyphal invasion of sinus tissue with an approximate time course of less than 4 weeks.^[3]

Endodontic emergencies are amongst the most important categories of dental emergencies where pain becomes the

critical aspect implicating endodontic infection. This poses dental professionals to be at high risk for nosocomial infections and thereby becoming the potential carriers of the disease. This can be attributed to the aerosol production, handling of sharps, and proximity to the patient's oropharyngeal region.^[4]

The incubation period for Covid-19 can range from 0 to 24 days which is the point of concern as the asymptomatic patients can act as carriers and also, they can serve as reservoir for the re-emergence of infection.^[5]

Characteristics of COVID-19

1. Fever and myalgia
2. Dry cough, sore throat
3. Shortness of breath, hyposmia, dysguesia^[6]
4. Nasal blockage
5. Crusting, proptosis, facial pain and oedema
6. Chemosis and ophthalmoplegia^[7]
7. Nausea, diarrhea
8. Arrhythmia and shock^[8]
9. Black eschar on hard palate or nasal cavity

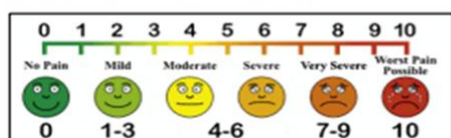
10. Histological features include mycotic infiltration of blood vessels, vasculitis with thrombosis, tissue infarction, haemorrhage with acute neutrophilic infiltrate^[9]
11. Radiographically, ground-glass opacities and bilateral patchy shadows are typically found in the chest.^[10]
12. Tissue necrosis, a hallmark of mucormycosis is often a late sign.^[11]

QUESTIONNAIRE

1) Are you in pain?

Yes or No

2) What is your level of pain on a scale of 0-10?



3) When did the pain begin?

.....

4) Do you have a dental abscess (Are your gums and/or face swollen)?

Yes or No

- If Yes, when did you first notice the swelling?

.....

5) Do you have a fever?

Yes or No

6) Are you having any trouble swallowing?

Yes or No

7) Are you having any trouble opening your mouth?

Yes or No

8) Did you experience any trauma?

Yes or No

- Please describe the trauma

.....

Fig. 1: An overview for assessment of the emergency.^[4]

Diagnosis

- History
- Clinical symptoms
- CT imaging findings (sequential morphologic changes observed are reversed halo sign followed by consolidation and finally, central necrosis and air-crescent sign.)
- Laboratory tests (Reverse Transcriptase Polymerase Chain Reaction tests on respiratory tract specimens)
- Sabourauds Dextrose Agar culture^[12]

Routes of transmission

Transmission mode can be direct or indirect. Direct transmission can occur through cough, sneeze, and droplet inhalation or can be contact transmission via oral and nasal mucous membranes, blood, oral fluids, conjunctival membrane and aerosols containing microorganisms generated from an infected individual

that are propelled at a short distance by coughing and talking without a mask.

Indirect transmission occurs with contaminated instruments and/or environmental surfaces, respiratory droplets or SARS-CoV-2 contaminated inanimate objects. Other variant is via saliva and feces of the affected patients alongwith nosocomial spread.^[13]

Excessive use of steroids in Covid-19 management usually suppress immunity and are suspected to be a ground reason for proliferation of opportunistic fungal infections.^[14] Portal of entry is made through the respiratory tract, exhibiting an astounding affinity for corresponding vasculature, where it proliferates within the internal elastic lamina causing thrombosis and infarction. The ultimate progression from paranasal structures alongwith the related sinuses directly leads to vascular occlusion by storming into superior orbital fissure, ophthalmic vessels, cavernous sinus, carotid artery or perineural route.^[15] Consequences usually encountered are infarction and necrosis due to vasculature invasion by hyphae, that specifically interacts with endothelial cells.^[16] This interaction triggers cell injury and subsequent hematogenous dissemination of fungi. Elevated levels of serum glucose, iron, and ketone bodies further facilitate fungal growth and induce the expression of GRP78 and CoH leading to enhanced efficacy of Rhizopus to invade host tissues, therefore, diabetic and patients on steroid therapy are more prone to mucormycosis.^[17]

Patient management

4 phases that are crucial in the dental practice:

- a. Patient triage
- b. Patients' entrance into the dental unit
- c. Dental treatment
- d. After treatment management.^[2]

Mild cases usually require symptomatic treatment and home isolation and no specific treatment is indicated. For severe cases, oxygen therapy is the major intervention.^[18]

1. Initial step is Telescreening and Triaging that includes telephonic conversation and scheduling of the appointments accordingly.
2. Contact details and address of all patients are recorded.
3. Sign boards and physical barriers to be placed at reception area.
4. Checking the patient's body temperature.
5. Waiting area should be well-ventilated and spacious that could accommodate patients at least at a 6 feet distance from each other.
6. Extraoral imaging should be followed with double barriered sensors.^[19]
7. Use of disposable instruments and devices.
8. Personal protective equipment are a must.
9. Pre-procedural mouth rinse with 0.2% povidone-iodine or 0.5-1% hydrogen peroxide.^[20]
10. Use of rubber dam for isolation.

11. The use of ultrasonic instruments, high-speed handpieces, and 3-way syringes should be minimized.
12. Use high-speed evacuation in the clinics.
13. Use clean, sterile water for humidifiers during in cases of mucormycosis.
14. Avoiding contact with the eyes, nose, and mouth with unwashed hands.
15. Disinfect inanimate surfaces using chemicals and mandatory to maintain a dry environment.^[21]
16. Contaminated waste with blood, body fluids, secretions and excretions should be treated in accordance with local regulations.

Dental procedures can be categorized into five categories:

- A. Emergency management for life-threatening conditions.
- B. Urgent conditions managed with minimally invasive procedures and without aerosol generation.
- C. Urgent conditions that need to be managed with invasive and/or aerosol-generating procedures.
- D. Non-urgent procedures.
- E. Elective procedures.^[22]

The provision of primary treatment are the three As:

- Advice;
- Analgesia;
- Antimicrobials (where appropriate)^[23]

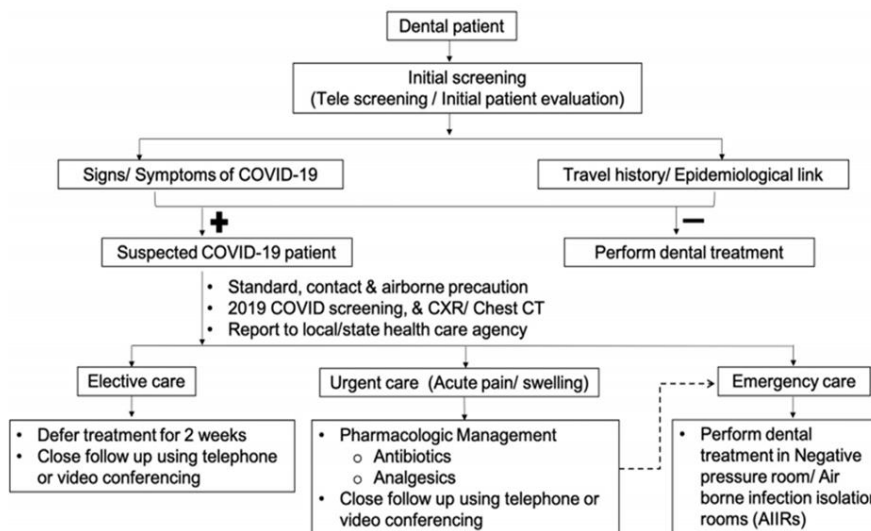


Fig. 2: An overview of patient screening and dental management for COVID 19^[4]

Recommendations for endodontic treatment during COVID-19

The outburst of Covid-19 has been tragic and catastrophic further amplified by Mucormycosis, also known as zygomycosis or phycomycosis was first described by Paltauf in 1885. This is a fulminant, potentially lethal, aggressive fungal infection that affects patients with altered immune system.^[24] Extensive usage of steroids and broad spectrum antibiotics during the management of Covid-19 has led to the initiation or exacerbation of a pre-existing opportunistic fungal disease.^[25]

Mucoraceae are ubiquitous saprophytic fungi, commonly residing in decaying matter and also found in bread, soil, air, dust and hospital ward rooms.^[26] There are certain specific pathophysiologic characteristics of COVID-19 that eventually permit invasion of secondary fungal infections, including a tendency to cause extensive pulmonary disease and the subsequent alveolo-interstitial pathology that enhances the risk of invasive fungal infections. Sometimes, immune dysregulation is also evident alongwith COVID-19, with reduced numbers of T lymphocytes, CD4+T, and CD8+T cells, may alter innate immunity.^[14]

At this time, endodontists are in a crucial stage as they are regularly called upon for the assessment and management of odontogenic pain, swelling, and dental alveolar trauma in suspected or confirmed Covid-19 patients.

Hereby, each patient is considered as infected or a potential carrier of this virus. If a tooth is diagnosed with a pathology like symptomatic irreversible pulpitis where pulp exposure has to be done, chemo-mechanical means of caries removal must be preferred under rubber dam isolation and a high-volume saliva ejector, followed by pulp devitalization to reduce the pain.^[8]

Patients can be divided into 4 types:

- 1) Subjects with known SARS-CoV-2 infection,
- 2) Subjects at potential risk of infection
- 3) Subjects with unknown risk of infection
- 4) Subjects who have healed from COVID-19.

Hands should be washed with soap and water for at least 20 seconds after contact with patient. An alcohol-based hand sanitizer with at least 60% alcohol can be used when soap and water are not available.

To prevent the contamination, all exposed surfaces should be covered with disposable protections, especially the working surfaces, dental chair and devices. The use of masks, goggles, long-sleeved water-resistant gowns and gloves is mandatory while treating patients, considering every patient as potentially contagious. All surfaces should be disinfected with sodium hypochlorite 0.1% or 70% isopropyl alcohol after every patient, followed by at least a 5-minute air change.^[2]

Thorough cleaning of surfaces with water and detergent and fumigating the operating room using hospital-level disinfectants such as sodium hypochlorite, quaternary ammonium compounds or isopropyl alcohol are efficient procedures.^[27]

For mucormycosis, surgical debridement is first line approach followed by Amphotericin-B deoxycholate, posaconazole or isavuconazole as an alternative in case of patients intolerant to amphotericin therapy.^[28]

This is a highly challenging situation as the inhalation of air borne particles and aerosols produced during dental procedures on patients with COVID-19 could potentially expose endodontists to the virus, thus placing them at high-risk. As a remedy, for vital pulp cases, vital pulp therapy might be helpful in terms of shortening the treatment time, thereby reducing the exposure. During root canal preparation, single-file nickel-titanium systems can serve the purpose of saving the working time. It will also prevent the need of re-sterilization eliminating any mode of transmission. Prognosis is dependent on multiple factors and early initiation of treatment is an important element. Once the diagnosis is confirmed, conservative management is started for the patient.^[29]

CONCLUSION

It is hoped that the guidelines proposed in this situation will help in the management of dental care around the world during this COVID-19 pandemic and provide a solid base for further healthcare guidelines development. Clinicians should be aware of the possibility of invasive secondary opportunistic fungal infections in patients infected with COVID-19 pandemic especially in patients with pre-existing risk factors and systemic disorders, where early diagnosis and treatment with the subsequent reduction of mortality and morbidity could be enabled. During the pandemic outbreak, patients may suffer from psychological stress and depression caused due to the discomfort, therefore, endodontists alongwith focusing on the best treatments of endodontic diseases must also seek for their psychological state at the times of emergency.^[30]

ACKNOWLEDGEMENT

I wish to express my deep sense of gratitude and profound thanks to Almighty, my co-authors and family for their unparalleled support and immense

encouragement towards the successful completion of this article.

REFERENCES

1. Gorbalenya AE, Baker SC, Baric RS, Groot RJ, Drosten C. The species severe acute respiratory syndrome related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol*, 2020; 1: 1-15.
2. Izzetti R. COVID-19 Transmission in Dental Practice: Brief Review of Preventive Measures in Italy. *J Dent Res*, 2020; 99(9): 1030-1038.
3. Chakrabarti A, Denning DW, Ferguson BJ, Ponikau J, Buzina W, Kita H. Fungal rhinosinusitis: a categorization and definitional schema addressing current controversies. *Laryngoscope*, 2009; 119: 1809-18.
4. Ather A. Coronavirus Disease 19 (COVID-19): Implications for Clinical Dental Care. *J Endod*, 2020; 46(5): 584-595.
5. Rothe C, Schunk M, Sothmann P. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. *N Engl J Med*, 2020; 382(10): 970-71.
6. Giacomelli A, Laura PL, Conti F. Self-reported olfactory and taste disorders in SARSCoV-2 patients: a cross-sectional study. *Clinical Infectious Diseases*, 2020; 71(15): 889-890.
7. Scheckenbach K, Cornely O, Hoffmann TK, Engers R, Bier H, Chaker A. Emerging therapeutic options in fulminant invasive rhinocerebral mucormycosis. *Auris Nasus Larynx*, 2010; 37: 322-8.
8. Meng L. Coronavirus Disease 2019 (COVID-19): Emerging and Future Challenges for Dental and Oral Medicine. *J Dent Res*, 2020; 99(5): 481-487.
9. Mohindra S, Gupta R, Bakshi J, Gupta SK. Rhinocerebral mucormycosis: the disease spectrum in 27 patients. *Mycoses*, 2007; 50: 290-6.
10. Guan W, Ni Z, Hu Y. Clinical characteristics of 2019 novel coronavirus infection in China. *New Engl J Med*, 2020; 382: 1708-1720.
11. Werthman AE. Mucormycosis with orbital compartment syndrome in a patient with COVID-19. *Am. J. Emerg. Med*, 2021; 42: 264-5.
12. Bourcier J, Heudes PM, Morio F. Prevalence of the reversed halo sign in neutropenic patients compared with non-neutropenic patients: Data from a single-centre study involving 27 patients with pulmonary mucormycosis (2003-2016). *Mycoses*, 2017; 60(8): 526-33.
13. Peng X, Xu X, Li Y. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci*, 2020; 12: 9.
14. Gangneux JP, Bougnoux ME, Dannaoui E, Cornet M, Ralph ZJ. Invasive fungal diseases during COVID-19: we should be prepared. *J Mycol Med*, 2020; 30: 1009-11.
15. Groote CA, Rhinocerebral phycomycosis. *Arch Otolaryngol*, 1970; 92(3): 288-292.

16. Bitar D, Van CD, Lanternier F. Increasing incidence of zygomycosis (mucormycosis), France, 1997-2006. *Emerg Infect Dis*, 2009; 15(9): 1395-401.
17. Spellberg B. Mucormycosis pathogenesis: Beyond *Rhizopus*. *Virulence*, 2017; 8(8): 1481-2.
18. Chughtai, A, Malik A. Is Coronavirus disease (COVID-19) case fatality ratio underestimated? *J. Glob. Biosecurity*, 2020; 2(1): 21-22.
19. List N: EPA's registered antimicrobial products for use against novel coronavirus SARS-CoV-2, the cause of COVID-19. Washington, DC: United States Environmental Protection Agency. Available at: <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sarscov-2>. Accessed March 18, 2020.
20. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. *J Hosp Infect*, 2020; 104: 246-51.
21. Hokett SD, Honey JR, Ruiz F. Assessing the effectiveness of direct digital radiography barrier sheaths and finger cots. *J Am Dent Assoc*, 2000; 131: 463-7.
22. Alharbi A. Guidelines for dental care provision during the COVID-19 pandemic. *Saudi Dent J*, 2020; 32(4): 181-186.
23. Drugs for the Management of Dental Problems During COVID-19 Pandemic. Scottish dental clinical effectiveness programme 2020.
24. Paltal A. Mycosis mucorina. *Virchows Arch Pathol Anat Physiol Klin Med*, 1885; 102: 543-64.
25. Horby P, Lim WS, Emberson JR, Mafham M, Bell JL, RECOVERY Collaborative Group. Dexamethasone in hospitalized patients with Covid-19--preliminary report. *N Engl J Med*, 2021; 384: 693-704.
26. Kolekar JS. Rhinocerebral mucormycosis: a retrospective study. *Indian J Otolaryngol Head Neck Surg*, 2015; 67(1): 93-96.
27. WHO. Use of disinfectants: alcohol and bleach. Infection prevention and control of epidemic-and pandemic-prone acute respiratory infections in health care. Geneva: WHO, 2014; 65.
28. Goldstein EJ, Spellberg B, Walsh TJ, Kontoyiannis DP, Edwards J, Ibrahim AS. Recent advances in the management of mucormycosis: from bench to bedside. *Clin Infect Dis*, 2009; 48: 1743-51.
29. Sabino-Silva R, Jardim A, Siqueira WL. Coronavirus COVID-19 impacts to dentistry and potential salivary diagnosis. *Clin Oral Investig*, 2020; 24: 1619-21.
30. Qu X, Zhou X. Psychological intervention in oral patients in novel coronavirus pneumonia outbreak period. *Chin J Stomatol*, 2020; 55: 3-4.