Post-COVID-19 Symptoms and Dental Management

Subjects: Dentistry, Oral Surgery & Medicine

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The available data regarding the short and long-term consequences of COVID-19 is still insufficient. This entry aims to provide information on the prolonged COVID-19 symptoms in recovered patients and their implications during dental management.

Post-COVID-19 Symptoms | Dental Management | long COVID | prolonged COVID-19 | Long COVID syndrome

1. Introduction

The novel human coronavirus COVID-19, responsible for the recently named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first identified in China in December 2019 and turned into a pandemic within a short period [1]. The most common clinical features of COVID-19 include dry cough, fever, dyspnea, myalgia, joint pain, fatigue, gastrointestinal symptoms, and anosmia/dysgeusia [2]. Although the lungs are the first target organ of COVID-19 infection, accumulating evidence indicates that the virus may exhibit infections in different organs, including the heart, blood vessels, kidneys, gut, oral cavity, eyes, and brain [3].

According to the World Health Organization (WHO), the mortality rate of COVID-19 patients is 3% to 5%. Reports have suggested that patients who survive COVID-19 may experience impairment or prolonged symptoms in their overall health status after their acute phase recovery [4]. According to the WHO, patients who recover from COVID-19 can have persistent symptoms such as fatigue, dyspnea, dry coughing, congestion or shortness of breath, loss of taste or smell, loss of hearing, body aches, diarrhea, nausea, chest or abdominal pain [5]. Other complications include acute kidney injury with little evidence of renal failure and hepatic impairment in severely ill patients [6]. Moreover, there have been records of changes in the clotting system, such as disseminated endovascular coagulopathy (DIC), decreased platelet count, and prolonged prothrombin time (PT). Additionally, hypercoagulability and potential thromboembolic disorders are a few of these patients' common manifestations [7] [8].

Nutritional status is a major health determinant for the recovery of COVID-19 patients, especially in people at risk for adverse outcomes, such as the elderly and those with underlying medical conditions. Previous literature has shown that prolonged intensive care unit stays lead to a decline in muscle mass and strength and anorexia. Moreover, following the COVID-19 infection, malnutrition was aggravated, which was responsible for poor recovery

and poor quality of life of discharged ICU patients [9]. Previous reports have associated worse outcomes of COVID-19 patients with low levels of circulating markers of nutritional status [5][9]. Nutrition deficiencies have been acknowledged across all the stages of COVID-19, especially in populations who are at higher risk of negative outcomes [10]. Although this “post-COVID syndrome” may linger or recur for weeks or months following the initial recovery, these recovered patients are not contagious to others during this time.

Additionally, COVID-19 acute infection, with associated therapeutic measures, could contribute to adverse oral health outcomes. The signs and symptoms in the oral cavity due to COVID-19 are taste disorders, unspecific oral ulcerations, desquamative gingivitis, petechial, and co-infections such as candidiasis [11]. Despite the many studies based on expert opinions on COVID-19 recovery, the clinical picture of the COVID-19 aftermath is still unclear. Dentists, being in close contact with the patient’s droplets and aerosols generated, must revise the operating protocols to protect the team and the patients from the risk of infectious diseases [12]. Since the long-term consequences of the current pandemic are unknown, these circumstances resulted in a “new normal” dentistry provision.

Several protocols and guidelines for reopening dental clinics and dental treatment have been issued by governments and regional medical and dental authorities, focusing on aerosol reduction and other preventive measures [13]. Studies have concluded that the usage of high-volume evacuators, fumigation using chlorine dioxide and hydrogen peroxide vapor (HPV) are effective for aerosol reduction in dental operating sites [14][15]. Additionally, implementing primary filters, UV light, plasma disinfection, HVAC systems and High Efficiency Particulate Air (HEPA), have resulted in 99.7% air filtration. Currently, researchers are developing protective devices to reduce aerosol dispersion in dental clinics, to prevent COVID-19 transmission [16].

2. Implications of COVID-19 on Online Triaging and Patients Management

A vast number of studies have reported tele dentistry as an emerging paradigm during this pandemic [17]. Modified structured telephone and online triaging should be implemented with an artificial intelligence-based dental screening software, such as Dental Monitoring and Smile Mate. Virtual consultations using these screening tools present advantages, such as building rapport with the patients before their first clinical appointment, improving patient care and engagement, and reducing unplanned appointments [18]. Home monitoring and follow-ups of these patients are essential for collecting data.

These COVID-19 recovered patients should be treated with utmost care and empathy. The family members should accompany these patients to monitor the dentists’ instructions at home. Patients should be scheduled according to their risk status. Appointments for high-risk patients should be scheduled at the end of a morning shift or at the end of an evening shift to minimize interaction with other patients in the waiting room. It is mandatory to avoid several patients in the waiting room, maintain social distancing of at least 2 m and face masks. Additionally, it is suggested that patients should not carry their personal belongings in the dental operative room. A summary of the proposed health assessments and dental setting guidelines for the treatment of COVID-19 patients is presented in Table 1.

Table 1. Suggested health assessments and dental setting guidelines for the treatment of COVID-19 patients.

Dental Care Phases	Suggested Evaluation and Dental Setting Guidelines
Primary Teledentisty Examination	Ask the patient to upload intra oral pictures in different perspectives using phone camera and tablespoons in the SmileMate
	Ask for the medical and medication history
	Ask the patient about the past and present signs and symptoms of COVID-19
	Ask the patient about the treatment received for COVID-19 (supplemental oxygen, antibiotics, anti-retroviral, HCQ, immunomodulators)
	Check the past diagnostic reports of COVID-19
	Share the comprehensive dental report based on Online dental screening software (SmileMate) with the patient
	Patient counselling and treatment recommendation should be advised
Comprehensive COVID-19 post-acute assessment	Oxygen saturation, Heart rate, Blood pressure assessment
	Lifestyle assessment (physical activity, diet, alcohol consumption)
	Ask for gastrointestinal symptoms
	Physical perfomance test (6 min walking, hand grip and chair side stand) for the elderly patients
	Psychiatric history and quality or life assessment
Dental facility considerations for COVID-19 recovered patient	The appointments for the patients who have persistent symptoms should be preplanned (either first or the last appointment)
	Shorter waiting time
	Mandatory use of facemasks in the waiting room
	Waiting area should allow social distancing (6-feet/2 m) apart
	Provision for tissue paper dispenser and foot operated waster bin
	Use of HEPA filters in dental care facilities with commercial split and centralized/window Acs
	Proper ventilated dental operatory rooms
	Administer frequent disinfection of touched surfaces with NaOCl and ethanol

Dental Care Phases	Suggested Evaluation and Dental Setting Guidelines
	Disinfecting the floors or the operatory room with 1000 mg/L chlorine
	'Critical' heat sensitive instruments should de disinfected with 2 %glutaraldehyde
	Waste disposal in accordance to the CDC guidelines
Dental radiography	Extraoral radiography (panoramic radiography or cone-beam CT)
Succesive follow-ups	Providing the patient with cheek-retractors

Patients with Prolonged Symptoms

The prolonged COVID-19 symptoms previously described present a challenge in dental care since these patients present a higher risk for oral diseases and/or higher risk for dental care associated complications, as illustrated in Table 2.

Table 2. Clinical considerations of post-COVID-19 patients and suggested dental management.

Clinical Consideration	Clinical Condition/Situation	Suggested Dental Recommendations and Management
Respiratory	Breathlessness	Periodic recording of oxygen saturation for a week by the patient prior to treatment
		Continous monitoring of oxygen saturation by "pulse oximeter" during the treatment
		Practice and train breathing techniques (inspiration to expiration ratio of 1:2)
		Bilateral mandibular blocks should not be administered
		Clinics must include medical emergency first aid kits (oxygen cylinders)
	Cough	Practice and train breathing techniques (inspiration to expiration ratio of 1:2)
		Antitussives or lozenges for immediate cough suppression.
		Chair position during the treatment: Upright or semi supine

Clinical Consideration	Clinical Condition/Situation	Suggested Dental Recommendations and Management
		position
Psychosocial	Fear in COVID-19 recovered pts.	Virtual consultations using AI based patient management screening tools
		Appointments to be scheduled after complete health assessment
	Fear and Anxiety in COVID-19 recovered pts	Family members should also accompany during the appointment.
		First or last time slot should be scheduled
		Screen the patients using "The Seattle System for anxiety and fear
Oral health		To be treated with utmost care and empathy
	Stress in COVID-19 recovered pts.	Psychotherapeutic interventions can be used
	Fear in Dentists	Learning about the virus and post-COVID symptoms
	Inflammatory reactions (salivary glands, tongue)	Dental follow-ups of recovered patients
	Pain	Acetaminophen (not exceeding 60 mg/kg/day or 3 mg/day)
		Oral health hygiene training (online, if necessary)
	Periodontal	Regular online follow ups (patient management software can be used)
Musco-skeletal	Associated sleeplessness and anxiety	Non-pharmacological (3 ps Technique by RCOT)
		Pharmacological interventions (tranquilizers, muscle relaxants or anxiolytics)

Clinical Consideration	Clinical Condition/Situation	Suggested Dental Recommendations and Management
		Pre-planning the treatment
	Fatigue	Short appointments and relaxing setting
Bleeding disorders	Active Bleeding	ASH guidelines for controlling bleeding (who are not under thromboprophylaxis)
Bleeding disorders	Pain	Acetaminophen (not exceeding 60 mg/kg/day or 3 mg/day)
		Endodontic treatment should be considered over extraction
(Hypercoagulability thromboembolic disorders/Congenital Bleeding Diathesis) cardiac Damages (Stress cardiomyopathy) [19]	Pain due to Irreversible Pulpitis/necrosis	Endodontic consideration: Copious irrigation with sodium hypochlorite sol.
		Endodontic consideration: Intracanal dressing to limit the bleeding from canals
		Surgical consideration: Short appointments
		Safe anaesthsia: Infiltration from the vestibule side of the mouth
		Surgical consideration: Resorbable sutures and haemostatic agent to be used
		Instruction to patient.: Maintain a pressure tampon for 1–2 h after extraction

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bleeding or influence platelet aggregation. If extraction is the last option, post-extraction instructions should include avoiding NSAIDs and maintaining a pressure tampon for more than 2 h after the extraction. Resorbable sutures should be used, and hemostatic agents can be considered to prevent secondary bleeding [20][21]. Local and systemic measures of bleeding control according to ASH or ISTH-IG guidelines could be followed in cases of intraoperative bleeding in these patients [21].

Additionally, thromboprophylaxis should be considered. Hence, consultation with the cardiac physician before planning the dental procedure is vital. In patients with confirmed COVID-19 infection, several changes in the coagulation system, such as a hypercoagulable state, were reported. Using warfarin, heparin-based therapy, and antiplatelet drugs for anticoagulation therapy, prolonged thromboprophylaxis is part of the therapeutic intervention for these patients [22]. Previous reports have suggested that unless there are signs of complications, such as pleural inflammation or superinfections, a cough can be best managed by breathing exercises [23]. The most

efficient management of chronic cough in dental care would be directing the patient to sit in a supported position and breathe in through the nose and out through the mouth slowly, while relaxing the chest and shoulders and allowing the tummy to rise. The chair position while performing the treatment should be in the upright or semi-supine position [24]. Antitussives or lozenges can be administered for cough suppression.

4. Oral Manifestations of COVID-19 and Its Management

Several studies of COVID-19 reported high prevalence of gustatory dysfunction, xerostomia, sialadenitis, and inflammatory reactions in the salivary glands and tongue. The literature also reported various opportunistic fungal infections, ulcerations, and HSV-1 infection due to COVID-19 therapeutic interventions. In recent literature, fungal infections typically Mucormycosis has been reported in post-COVID patients [25]. It is attributed to occur as a consequence of steroid therapy and in uncontrolled diabetics. Other reports have shown secondary infections such as gingivitis and periodontitis due to dysregulated inflammatory response and cytokine storm. Furthermore, reports of painful herpetic recurrent stomatitis on the palate accompanied by sore throat, blisters on internal labial mucosa with desquamative gingivitis, necrotic interdental papillae with unprovoked gingival bleeding, ulcers on tongue, erythematous lesions and erosions on lips and buccal mucosa exist [26][27][28][29]. Due to a lack of evidence on pharmacological interventions against COVID-19, oral and systemic multidrug-resistant infections can be a potential challenge to treat. However, recent studies [28][29] attempted to classify the oral manifestations of COVID-19 based on the features of the lesions, the timing of presentations, and the therapies into the following:

1.*Probably pre-existing conditions: Geographic tongue, fissured tongue.*The following topical management of oral
2.Sars-CoV-2-related lesions: Early ulcerative lesions, blisters, early erythema multiforme-like lesions, and petechiae.
3.Treatment-related lesions: Late ulcerative lesions, late erythema multiforme-like lesions, 4.Candidiasis, angina bullosa, spontaneous oral hemorrhage, and petechiae.
*5.Lesions related to poor oral hygiene: Ulcero-necrotic gingivitis.*diagnosis can be administered:

- *Hyaluronic acid gel and chlorhexidine 2% mouthwash or gel (twice a day) for 14 days in patients with ulcero-erosive lesions* [30][31]*;*
- *Miconazole Nitrate twice a day in patients with cytological diagnosis of candidiasis.*
- *Tranexamic acid for local hemorrhages* [32]*.*
- *Previous studies have suggested a biopsy in the absence of healing after 14 days among mild COVID-19 patients with prior rinsing with chlorhexidine 2% mouthwash for at least 1 min.*

It is recommended to perform an extensive intraoral examination in recovered COVID-19 patients to find any related oral manifestation [33]. Dentists should have a high degree of clinical suspicion and keep COVID-19-associated Mucor mycosis (CAMCR) in the differential of a severely ill patient with COVID-19 and diabetes

mellitus, especially if rhino-orbital or rhino-cerebral presentations are noted. Additionally, the dentist should examine the salivary glands and saliva flow to perform early diagnoses related to changes in the glandular parenchyma that might be affected by the virus.

Table 3 summarizes the clinical conditions associated with the prolonged COVID-19 symptoms and the suggested dental recommendations and management.

Table 3. Suggested health assessments and dental setting guidelines for the treatment of COVID-19 patients.

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	Check the past diagnostic reports of COVID-19
	Share the comprehensive dental report based on Online dental screening software (SmileMate) with the patient
	Patient counselling and treatment recommendation should be advised
Comprehensive COVID-19 post-acute assessment	Oxygen saturation, Heart rate, Blood pressure assessment
	Lifestyle assessment (physical activity, diet, alcohol consumption)
	Ask for gastrointestinal symptoms
	Physical perfomance test (6 min walking, hand grip and chair side stand) for the elderly patients
	Psychiatric history and quality or life assessment
Dental facility considerations for COVID-19 recovered patient	The appointments for the patients who have persistent symptoms should be preplanned (either first or the last appointment)
	Shorter waiting time
	Mandatory use of facemasks in the waiting room
	Waiting area should allow social distancing (6-feet/2 m) apart

Dental Care Phases	Suggested Evaluation and Dental Setting Guidelines
	Provision for tissue paper dispenser and foot operated waster bin
	Use of HEPA filters in dental care facilities with commercial split and centralized/window Acs
	Proper ventilated dental operatory rooms
	Administer frequent disinfection of touched surfaces with NaOCl and ethanol
	Disinfecting the floors or the operatory room with 1000 mg/L chlorine
	'Critical' heat sensitive instruments should de disinfected with 2 %glutaraldehyde
	Waste disposal in accordance to the CDC guidelines
Dental radiography	Extraoral radiography (panoramic radiography or cone-beam CT)
Succesive follow-ups	Providing the patient with cheek-retractors

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Elderly patients who have survived are at high risk of sarcopenia, malnutrition, depression, and delirium. This poses a challenge for the dental team to perform relationship-based care for patients with complex needs. Atypical presentation of fatigue and musculoskeletal weaknesses for a prolonged duration in elderly individuals poses a challenge for dentists to complete complex dental procedures in a short period and with fewer appointments. The dental fear and anxiety can be categorized under "The Seattle System", and as per the guidelines, dental anxiety can be managed [33][34][35]. Psychotherapeutic interventions such as Ost's applied relaxation technique, Jacobsen's progressive muscular relaxation, functional relaxation, rapid relaxation technique, and autogenic relaxation can also be used to relieve stress, especially for uncooperative patients [35][36]. Hence, patients' scheduling and triaging are critical parameters to be managed before re-starting the dental setup.

It will be challenging for patients who suffer from chronic cough to treat with rubber dams and perform extractions and other complex dental treatments, especially in elderly patients.

Despite the advantages of tele dentistry, setting up an online follow-up for elderly patients with cognitive impairment or dementia and mental illness (for instance, depression, anxiety) will be challenging. Last, accessibility to elderly patients residing in long-term care institutions is a barrier, as caregivers are generally limited and poorly trained to address oral health care.

While the current guidelines are a helpful starting point to move our practice forward, they should be expanded to include the post-COVID-19 patients, many with prolonged symptoms [37][38]. Future research should be carried on the long-term effects of the COVID-19 virus in the oral cavity and the upper aerodigestive tract, effects of thromboprophylaxis in emergent dental treatment, and safe administration of perioperative antibiotics and analgesics in post-COVID-19 patients.

This will help dental teams in better preparedness and management of recovered COVID-19 patients with prolonged symptoms.

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