The Expanded Role of Dentists in the COVID-19 Pandemic Worldwide

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Abstract

The COVID-19 has spread globally and ensued several global restrictions with consequences of unknown long-term proportions, currently placing a strain on the healthcare system worldwide. This review aims to present the role of dentists in the COVID-19 pandemic in various aspects of dentistry, including general dentistry and restorative dentistry. Various studies and reports on COVID-19 were analyzed. Literatures on 2019 novel coronavirus disease (COVID-19) were explored using key words “COVID-19”, “COVID”, “dentistry”, “oral health”, “oral cavity” in Google Scholar, PubMed/Medline, and Scopus databases.

It was found that dentists, dental specialists, dental assistants, dental staff, and patients are potentially at higher risk of COVID-19 infection during dental treatments. There is an association between the oral cavity and systemic diseases in the context of COVID-19 disease caused by SARS-CoV-2 virus. There is a great role of dentists in the COVID-19 pandemic in various aspects of dentistry, including general dentistry and restorative dentistry.

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Introduction

The importance of the oral cavity and role of dentists in regard to infectious systemic diseases has experienced a renewed interest in the context of the 2019 novel coronavirus disease (COVID-19) caused by the SARS-CoV-2 virus[1,2]. The geographic distribution of 14-day COVID-19 cases worldwide, as of 2021-week 22 to 2021-week 23 (figure 1)[1]. COVID-19 has resulted in several global restrictions with the consequences of placing strain on the healthcare system worldwide. This review aims to present the role of dentists in the COVID-19 pandemic in various aspects of dentistry, including general dentistry and restorative dentistry.

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Clinical Signs of COVID-19

Fever, shortness of breath, sore throat, dry cough, headache, diarrhea, and dyspnoea are among the cardinal symptoms of COVID-19[3]. An increasing number of COVID-19 positive patients with hyposmia and anosmia, reduced and loss of smell, respectively, have been reported since February this year, as additional symptoms[4]. COVID-19 positive patients may develop loss of taste or smell without other noticeable symptoms[4]. On an average, about 53% of COVID-19 positive patients develop smell disturbance, and about 44% develop taste disturbance[5].

Acute disturbances in olfaction are common in viral infections, such as upper respiratory tract infections[6]. This may be related to nasal congestion and prevention of air from reaching the olfactory epithelium or due to nasal

inflammation. COVID-19 associated anosmia is suggested to be caused by a different mechanism, as none of the mechanisms have been detected[7]. The genes for angiotensin-converting enzyme 2-receptor (ACE2) and transmembrane serine protease 2 (TMPRSS2) are critical for entry of the Sars-CoV-2 and have been identified in support cells, stem cells, and perivascular cells of the olfactory epithelium. However, these receptors were not detected in olfactory sensory neurons. These findings suggest that in COVID-19 patients, the SARS-CoV-2 infection of non-neuronal cell type might lead to anosmia and related disturbances in odor perception[7].

Gustation is known to be affected by olfactory dysfunctions[8], as they are closely related senses, with the involvement of the trigeminal nerve[9,10]. ACE-2 is necessary to convert Angiotensin II to Angiotensin-(1-7) in the process of blood pressure regulation and is present on a wide range of epithelia, including alveolar epithelial cells and capillary endothelial cells[11]. In the oral cavity, ACE-2 is expressed both in the gingival and buccal mucosa, although to a larger degree in the epithelial cells of the tongue[12]. Interestingly, dysgeusia is a frequently observed adverse effect of ACE-inhibitors[13] and ACE2-receptor blockers[14,15]. Angiotensin II in murine taste buds is found to be critical in altering gustatory sensitivity[16]. Therefore, it may be suggested that inhibition of ACE-2 and accumulation of Angiotensin II in taste buds may explain the COVID-19 associated dysgeusia[17].

Huart and colleagues[18] suggested that olfactory and taste sensations, with high specificity and sensitivity, may be used as a screening test of potential COVID-19 positive patients. Such a test is particularly important as subtle taste and olfactory disorders may not be noticed by the patient. Interestingly, a retrospective study identified xerostomia as an additional prodromal sign, or even as a sole manifestation[19]. Dentists could represent the ideal first-line defense against COVID-19 with knowledge of the orofacial complex and by screening routine patients.

COVID-19, Stress and Temporomandibular Disorders (TMD)

The outbreak of COVID-19 has led to psychological problems and compromised mental health status, not only in people who suffered from COVID-19 but also in individuals in self-isolation, practicing social-distancing, and quarantine[20,21]. Alongside, people suffer from fear, anxiety, stress and self-efficacy[22], and this has also resulted in COVID-19-related suicides[23]. Most vulnerable individuals are those with existing mental health problems such as loneliness and depression. Enforced isolation and quarantine have interrupted normal social lives causing emotional imbalance, economic shutdown, financial and future insecurities, and psychological fear.

Temporomandibular disorder (TMD) involves pain and dysfunction of the masticatory apparatus and the temporomandibular joint (TMJ). History of trauma, stress, drinking alcohol, psychosocial impairment, and catastrophizing are related to TMD[24-27]. Anxiety, depression, and stress contribute to chronic upregulation of the hypothalamic-pituitary-adrenal (HPA) axis, which leads to TMD[24]. Hence, TMD may be correlated with COVID-19. The consequences of anxiety, depression, and stress in people from the outbreak of COVID-19 may lead to increased incidence and severity of TMD[28].

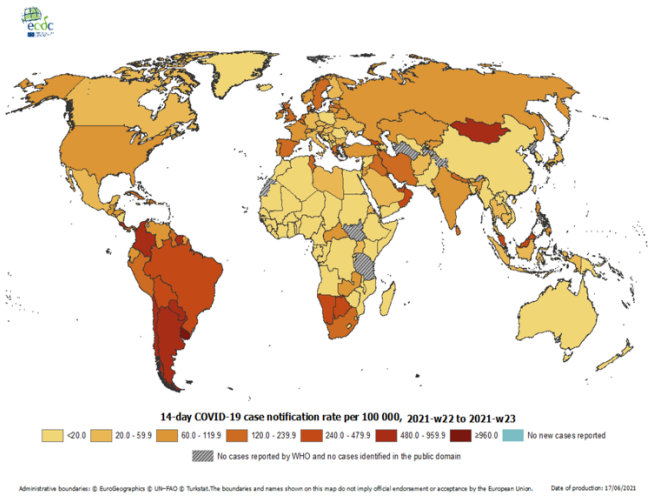

Figure 1. Problems faced by the people after the earthquake.

Saliva and COVID-19

Extensive testing is key in controlling a pandemic like COVID-19. Although naso/oropharyngeal swabs (NOS) are the most used instrument to collect biological samples for COVID-19 testing, several recent studies have suggested that saliva can be an alternative to NOS[29].

The use of saliva for COVID-19 testing offers several advantages as compared to the

NOS. Saliva collection is less invasive as compared to NOS; saliva can be self-collected, thereby reducing the risk of disease transmission to healthcare workers. Furthermore, as saliva collection does not require personal protective equipment (PPE) and collection swabs, saliva sampling is more cost-effective than NOS[30,31]. Recent studies have extensively evaluated the performance of saliva for COVID-19 testing and suggested that the sensitivity and specificity of saliva are comparable to that of NOS[32-35]. Besides, saliva testing seems to apply to individuals with severe symptoms to mild or asymptomatic ones. Based on these promising results, several countries are planning on or currently running saliva-based COVID-19 testing in several European countries.

The scientific basis for the suitability of saliva for COVID-19 diagnosis is the presence of SARS-CoV-2 in saliva, probably coming from upper or lower respiratory tracts, or infected salivary glands, or both. The presence of live SARS-CoV-2 particles in the saliva has several implications related to saliva sampling and clinical dentistry. Spillage of saliva must be avoided while collecting saliva samples to avoid infection of lab personnel and contamination of the lab environment. Almost all procedures related to the diagnosis and treatment of oral diseases involve either close contact with saliva or aerosol production containing saliva. This underscores the importance of the implementation of proper hygienic methods and measures to reduce aerosol production to prevent and minimize the spread of SARS-COV-2 through saliva.

Oral Cavity and COVID-19

The dentist's role in the early detection of COVID-19 positive patients is further emphasized as, in addition to the symptoms, several lesser-known symptoms may appear in association with COVID-19. These include rash, urticaria, vasculitis, and varicella-like vesicles [36,37]. The skin may not be the dentist's area of expertise, however, there are reports of oral mucosal lesions as well that are developed in suspected or confirmed COVID-19 positive patients.

To this date, eight suspected cases of oral lesions associated with COVID-19 have been reported. Five of these were confirmed to be positive, the three remaining ones were suspected based on clinical manifestations[38-40]. The reports included painful lesions of the hard palate, dorsum of the tongue, gingival mucosa, as well as the labial and buccal mucosa. The lesions were characterized as vesiculobullous ulcers and blisters, similar to herpetic lesions and aphthous ulcers[3] [41]. The third case by Martín Carreras-Presas et al.[39] showed lesions similar to erythema multiforme. Patel et al.[42] reported clinical necrotizing gingivitis in a patient suspected with COVID-19, suggesting a relationship between COVID-19 and bacterial co-infections.

Such oral signs and symptoms may be induced by stress or poor oral hygiene. The lesions have also been proposed to be the result of viral exanthem[43]. However, the latter poses diagnostic challenges as several viral agents may cause similar exanthems[39]. COVID-19 co-infections, possibly responsible for the reported cases, are overlooked and poorly understood, and are probably highly under-represented[44]. Routine examinations of the oral cavity of COVID-19 suspected or confirmed cases should be encouraged[45]. These lesions manifested before a positive test was confirmed. Thus, oral signs and symptoms may be the early signs of COVID-19. Therefore, the role of the dentist to identify COVID-19 positive patients at an early stage, could be critical. However, more studies will be necessary to confirm this hypothesis[43].

Patel and Sampson[46] proposed that COVID-19 infection may predispose individuals to necrotizing periodontal diseases by co-infection with *Prevotella intermedia*. High bacterial levels of *P. intermedia*, *Treponema denticola, Streptococci, Veillonella,* and *Fusobacterium* have indeed been reported in COVID-19 positive patients[47]. The Sars-CoV-2 may therefore predispose patients to necrotizing periodontal diseases. In addition, periodontal diseases and COVID-19 do share several similarities.

As discussed previously, ACE-2 is expressed in the oral cavity of murine and human subjects, fibroblasts of the gingiva and periodontal ligament are no exception[48]. Periodontal disease, characterized by deepening of periodontal pockets because of biofilm colonization, may affect SARS-CoV-2 load. Periodontal pockets may harbor not only bacteria but viral agents as well, such as herpes simplex. It can be hypothesized that such pockets may provide a reservoir environment for SARS-CoV-2 to replicate and either mix with saliva or enter the

circulatory system[49].

It has been suggested that an unclean oral cavity may contribute to persistent viral shedding due to accumulated viral nuclei. For patients at risk of COVID-19, it is recommended to brush teeth with toothpaste twice a day, for two minutes[50]. Several factors such as smoking, older age, cardiovascular disease, and diabetes, linked to the severity and complications of COVID-19 are indeed shared by periodontal disease. Therefore, it is reasonable to suspect that periodontal status may contribute to identifying patients at risk for COVID-19[51]. However, about 52% of deaths due to COVID-19 occur in healthy individuals without systemic diseases. As an example of why, most deaths, estimated to be 95%, during the Spanish flu of 1918, were attributed to bacterial co-infections[52]. Zhou and collaborators[53] observed that among patients with severe COVID-19, half of them died from a secondary bacterial infection. By combining an antiviral agent with an antibiotic, the success rate of treatment significantly increases, as evident in several studies. This highlights the potential involvement of bacteria in COVID-19 related deaths.

Further, the risk of aspiration pneumonia is increased in the presence of untreated periodontitis as cytokines and bacteria may be aspirated to cause inflammation or infection in the lungs. A study of chronic periodontitis patients treated over 11 years, showed a significantly lower risk of pneumonia than the general population[54]. Improved oral care/health also resulted in a significant reduction in post-pneumonia mortality, as well as a lower incidence of pneumonia, and a lower incidence of ventilator-associated pneumonia as well. In summary, COVID-19 may be associated with poor oral hygiene. Improved oral health care, early diagnosis, and treatment by the dentist may reduce the risk of severe COVID-19[55].

COVID-19 AND Dentistry

As the SARS-CoV-2 has been suggested to be transmitted via droplet, fomite and contact, dental professionals are highly susceptible to Sars-CoV-2 infection[56]. Updated resources for dental professionals have been given by the Australian Dental Association (ADA) [57]. The critical information and resources consist of a) ADA dental service restrictions in COVID-19, b) COVID-19 Decision trees, c) Managing PPE resources and d) Managing COVID-19 in the practice. One of the key reasons for this is the fact that dental examination and treatment require close contact between the dentist and naso/ oropharyngeal region of the patient[58,59]. Additionally, the use of high-speed handpieces during dental treatment generates aerosols, a mechanism in which the virus can spread and persist if not adequately captured[60,63]. Not only is the dental personnel's role of minimizing spread by pre-procedural rinses and aerosol reduction essential during treatment[64], but also by the use of PPE, proper screening of patients, and triage[65]. As a result of the partial lockdown of some dental practices and reduced patient flow, it has facilitated the rise of teledentistry[66]. Because of isolation due to lockdown, its psychological impact on anxiety, and the negative impact of bruxism, the incidence of TMD has been suggested to rise[67,68]. To reduce aerosol transmission, oral appliance therapy as a suggested first-line treatment of obstructive sleep apnea has been proposed rather than CPAP[69-71]. Importantly, oral health's impact on COVID-19 disease severity has been highlighted and thoroughly discussed[50,51]. The role of the dentist in this pandemic is becoming increasingly apparent. The dentist has profound knowledge of the oral cavity and its surrounding structures, compared to other health professionals. The dentist's role in future COVID-19 diagnostics, e.g., by saliva testing or by clinical dysgeusia and anosmia, should be seriously considered[30].

Pre-procedural oral rinses may become standard routine from now on. A mild form of COVID-19 has shown the pharyngeal virus shedding to be 1000 times higher than the concentration of SARS[72]. To inactivate the virus in the oral cavity and thus to reduce aerosol contamination, a pre-procedural rinse of 1% hydrogen peroxide has been recommended, based on the effectiveness of other coronaviruses[62]. A concentration of 3% is superior to 1% for shorter rinse time. Requirements of a pre-procedural rinse as means of viral prophylaxis include safe contact with oral and nasopharyngeal mucosae, inactivating effect of virus within a decent amount of time, about a minute[73].

Chlorhexidine gluconate (CHX), a commonly used rinse, may inactivate several types of viruses. However, the data regarding coronavirus is ambiguous due to differing methods[73]. Basso et al.[74] have proposed the

following protocol:
1. Gargle with 1% hydrogen peroxide mouthwash for at least 15 seconds with a final rinse of 30 seconds. Do not rinse with water.
2. Immediately proceed to rinse with 0.20% CHX mouth rinse for at least 60 seconds and then gargle for at least 15 seconds. Do not rinse with water. Additionally, Basso et al.[74] has highlighted the importance of gargling, as the virus may be localized in the upper respiratory tract and tonsillar area.

Iodophor has been shown to have an equal effect as 70% ethanol on SARS-CoV-2[75]. Isodine® (7%, Mundipharma Pharmaceuticals Ltd, Singapore) is a commercial mouth rinse based on iodophor. Significant reductions of SARS-CoV-2 viral load after 15 seconds of exposure have been observed[76]. Similar results have been reported with Betadine®, a 1% iodophor formulation (Mundipharma, Limburg, Germany). This mouth rinse does, however, carry the risk of drug-drug interactions and should not be used during pregnancy and breastfeeding[74]. With the persistence of the SARS-CoV-2, pre-procedural mouth rinses are of great importance. Their use can be translated to routine use in all patients or selected groups of patients (e.g., presenting with certain airway symptoms or recent fever) to reduce general viral and bacterial load during dental treatment and consultations in the future. The use of hydrogen peroxide is cost-effective and does not induce resistance in bacteria as opposed to chlorhexidine[77-79].

Teledentistry and COVID-19

Concerns of SARS-CoV-2 becoming endemic are evident[80]. The dental practice may therefore have to develop permanent concepts of safe practice to reduce the risk of transmission. Teledentistry is such a concept, reducing face-to-face consultations with the use of information technology. The smartphone is a fitting medium, facilitating easy communication by text, audio, and visuals through video and photography.

Teledentistry involves several subunits. The most common subunit involves teleconsultation, where patients or healthcare providers may consult specialists or other health care professionals[81]. Telediagnosis, with the exchange of videos, data and images, oral lesions may be diagnosed[82]. Telediagnosis is used in the screening of oral lesions, including potentially malignant lesions[83] and dental caries[84,85]. In addition, telediagnosis is shown to be reliable with a reported sensitivity of 93.8% and specificity of 94.2%[86]. This has also been shown to reduce the need for referrals to specialists[87]. There exist several systems making telediagnosis possible, including Mobile Mouth Screening Anywhere (MeMoSA®)[88] and CellScope, a mobile microscope, both aiding in the early detection of oral cancer [3] [89]. During the current COVID-19 pandemic, WhatsApp and similar applications have been highly beneficial to reduce face-to-face diagnostics[81,90]. Teletriage, the assessment of patient symptoms to decide the appropriate order of patients needing treatment based on urgency, reduces the number of unnecessary face-to-face contacts[91,92]. Telemonitoring reduces the need for frequent patient visits to monitor disease progression and outcome of treatment[93]. It has shown to be a promising tool during this pandemic, thereby cutting down on both cost and waiting time[94].

Altogether, teledentistry is a fitting complement to face-to-face dentistry during this pandemic and might be a permanent complementary solution in the future. However, teledentistry is dependent on visual quality and remote examination. Certain examinations requiring tools, training and equipment, or untrained remote health professionals, pose a serious limitation in teledentistry[95].

Conclusion

COVID-19 has resulted in several global restrictions with consequences of unknown long-term proportions, at present putting a strain on the healthcare system worldwide. The consequences of anxiety, depression, and stress in people from the outbreak of COVID-19 may lead to TMD. The dental procedures should be done with high standards of care and infection control by following proper recommendations. Personal protective equipment, patient screening, hand hygiene practices, mouth rinsing, disposable instruments, use of rubber dam, reducing use of ultrasonic instruments, treating suspected or confirmed COVID-19 patients in separate rooms and disinfection of the inanimate surfaces help in protecting clinicians and patients.

Declaration of interest

The authors report no conflict of interest.

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