

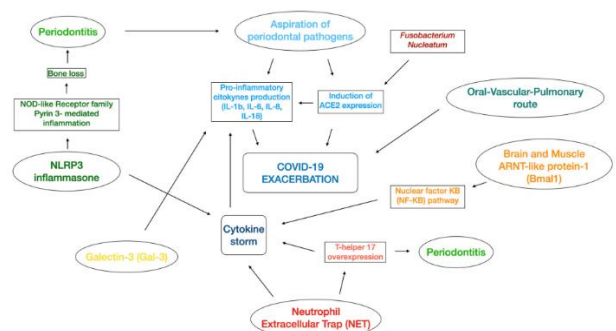
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Moreover, this review navigates through the implications of the pandemic on oral healthcare delivery, discussing the challenges faced in accessing dental services, altered oral hygiene practices, and the paradigm shift in preventive and therapeutic approaches for managing periodontal disease in COVID-19 era.

The primary cause of gingival irritation, or gingivitis, is the formation of bacterial biofilms. Therefore, for periodontal disease to progress to destructive periodontitis, there needs to be a decrease in the anti-bacterial mechanisms within the gingival sulcus, as well as a microbial imbalance that encourage the growth of particular bacterial species. Though formerly thought to be a local issue, it is now clearly evident

Several research have been conducted in the last three years to try and establish a relationship between COVID-19 and Periodontitis. The inhalation of periodontopathic bacteria triggers the production of angiotensin-converting enzyme 2 (ACE2), a receptor for SARS-CoV-2. Subsequently, ACE2 receptor cleaves the S protein, which is critical for the growth of SARS-CoV-2, by the production of proteases, potentially establishing a link between them (Figure 1). Furthermore, the lower respiratory tract produces more inflammatory cytokines as a result of periodontopathic bacteria. *Fusobacterium nucleatum* (CSF) culture supernatant was shown to upregulate IL-6, IL-8 production and expression of ACE2 in human respiratory epithelial cells, according to an *in vitro* investigation<sup>3</sup>.



Furthermore, metalloproteases that break down the dental support tissue, prolonged inflammation in the periodontal

ligament, elevation of inflammatory cytokines such as interleukins (ILs) 1 $\beta$ , 4, 6, 7, and 17, tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ), and C-reactive protein (CRP) can all lead to changes in the structure of the periodontium as a result of periodontitis. Individuals diagnosed with moderately advanced periodontitis exhibit increased levels of blood indicators enhancing the advancement of COVID-19. These markers are blood cells, lymphocytes, D-dimer, HbA1c, and concentrations of D vitamins. Patients with a history of periodontitis may therefore be more vulnerable to COVID-19 exacerbations.<sup>4-5</sup>

### COVID-19 and Oral Microorganisms

**Michael J. Cox and colleagues**<sup>6</sup> emphasized the significance of co-infections in COVID-19 outcomes, raising an overlooked aspect—oral bacteria's potential role in facilitating these co-infections. Poor oral hygiene, recognized as a catalyst for oral dysbiosis, increases pathogenic bacteria prevalence. Periodontal disease enhances susceptibility to bacteraemia. Metagenomic analyses have repeatedly highlighted cariogenic and periodontopathic bacteria in COVID-19 patients, reinforcing the inter-relationship of oral microbiome and COVID-19 complications. Oral bacteria, implicated in respiratory diseases, may contribute to severe COVID-19 complications and are associated with systemic diseases like diabetes and cardiovascular issues. Evidence suggests that improving oral hygiene can notably enhance clinical outcomes in pneumonia cases, reducing mortality rates.

### Is There A Possible Sars-Cov-2 Reservoir in Periodontal Pockets?

According to **Badrán et al**<sup>7</sup>, periodontal pockets may provide an environment that is conducive to virus survival and reproduction, and as a result, they may serve as an extra site of infection in individuals who test positive for COVID-19. Periodontal tissues may become infected with a virus directly from the mouth, through the bloodstream, or through immune cells that have become infected. The persistent inflammatory reaction observed in periodontal disease-affected areas may introduce SARS-CoV-2-infected mononuclear cells. Therefore, it's reasonable and plausible to think that the patient's saliva might further contaminate the periodontal pocket's crevicular fluid, which might include a virus that travels there from infected mononuclear cells.<sup>8</sup>

Although this has not yet been demonstrated experimentally, periodontal pockets interact with the circulation and oral cavity through capillary complexes, indicating that they should be investigated as potential SARS-CoV-2 reservoirs. This notion may be extended to implant regions as greater inflammation and EBV prevalence have been found in peri-implant locations as compared to healthy sites.<sup>9</sup>

### Is Compromised Periodontal Health Associated With A Higher Death Rate in Covid-19 Individuals?

Periodontal disease involves mechanisms like Neutrophils extracellular traps and the release of inflammatory factors, possibly contributing to systemic inflammation and complications like acute respiratory distress syndrome (ARDS) and hyperinflammatory states seen in COVID-19. There's speculation about periodontal disease potentially predisposing individuals to severe outcomes in COVID-19.

**Ramanan Laxminarayan and colleagues**<sup>10</sup> in a study on COVID-19 patients with conditions like diabetes, hypertension, circulatory problems, cancer, and respiratory ailments, had heightened mortality risk. Building upon this, a relationship between periodontal disease and COVID-19 is suggested, noting its potential impact on disease severity and exacerbation of existing comorbidities. A study in PGIMER (Chandigarh, India), on 78 COVID-19 patients reported a higher mortality rate in patients with Periodontitis than those without. There is a correlation between the severity of periodontitis and a higher likelihood of hospitalization, ventilation, COVID-19 pneumonia, and mortality following SARS-CoV-2 infection. The importance of further research and clinical trials to understand this interplay and long-term effects is emphasized for informed interventions.<sup>11</sup>

### Implications of the Pandemic on Oral Healthcare and Periodontal Disease Management

Since dentists are the group most at risk, stringent controls should be put in place to stop the pandemic from spreading. As per the rules provided by the Ministry of Health and Family Welfare, the precautions were classified as:<sup>12-13</sup>

- Dental operatories modifications
- Modifications at patient-level screening and examination.

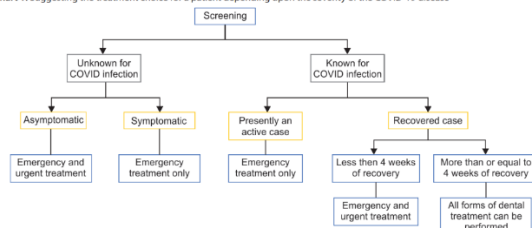
The dental operatory modifications are divided into three phases:

1. **Phase I: The preparatory phase** involves managing clinic areas and includes measures like equipping the entrance with sanitization facilities and masks, conducting temperature checks, installing shields at reception, providing patient education on COVID-19, encouraging digital transactions, and maintaining social distancing in waiting areas.
2. **Phase II: The implementation phase** focuses on patient and equipment hygiene. This includes patient mouth rinsing with diluted povidone iodine, chair and instrument sanitization with sodium hypochlorite, and daily fumigation to prevent infection spread.
3. **Phase III: Follow-up** involves monitoring patients for COVID-19 symptoms for 7-14 days post-visit. Health workers must undergo COVID testing and take prophylactic hydroxychloroquine if any symptoms are reported.

Modification at patient-level screening and examination is based on urgency and potential COVID-19 status.

**Alharbi et al.'s**<sup>14</sup> classification of dental treatments and proposes additions for periodontal surgical procedures and reconsideration of emergency needs. It categorizes procedures into emergency, urgent, and elective treatments for patients with unknown or known COVID status. The emphasis is on minimizing aerosol release during treatment and favouring hand instruments where possible. It also recommends utilizing negative pressure chambers with powerful suction to stop the transmission of aerosols.

Flowchart 1: Suggesting the treatment choice for a patient depending upon the severity of the COVID-19 disease



The treatment of periodontal diseases involves a classification based on urgency, although no established literature supports such categorization. This review attempts to create a classification aligning with the AAP's 2017 system. Gingivitis, the initial stage, may require oral prophylaxis and is considered elective. Implant-related issues, pericoronitis, and abscesses are urgent or emergencies, depending on severity. Procedures are approached cautiously due to aerosol concerns, with intervals between appointments for COVID-19 assessment. A phone consultation may be used to discuss elective procedures including regular scaling, depigmentation techniques, frenectomies, pericoronitis, and follow-up visits by giving appointments later. Priority should be given to emergency and urgent problems, respectively, and these patients should be scheduled for a later appointment. These classifications, subjective to the authors' clinical experience, necessitate further analysis for establishing standardized categories for periodontal conditions.

### Integrative Approaches and Future Directions

Interdisciplinary collaboration among dental, medical, and public health professionals is crucial to comprehensively manage these intertwined health concerns. Integrated approaches should prioritize early identification and joint management of periodontal disease in COVID-19 patients, acknowledging the potential bidirectional relationship between the two. Strategies may include optimizing oral health protocols in COVID-19 care, emphasizing oral hygiene practices, and considering the effect of periodontal health on COVID-19 outcomes.

Subsequent investigations ought to concentrate on clarifying the specific processes that underlie the inter-relationship of COVID-19 and periodontal disease, as well as investigating how oral health influences the intensity and trajectory of the viral infection. Furthermore, clinical trials examining customized therapies aimed at oral health in the

context of managing COVID-19 may provide insightful information.

### Conclusion

Reducing the infection's spread is essential for effectively combating the COVID-19 pandemic. Strict safety and preventive protocols can be put in place with the identification of possible virus reservoirs in COVID-19 patients and susceptible individuals for antiviral intervention on SARSCoV-2 infection.

It is undeniable that general health and dental health are related. It can be deduced that periodontal disease and COVID-19 problems may be connected based on the scant and ambiguous data available. To further understand the effects of the condition, more research is required.

### Source of Funding

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### Conflict of Interest

None.

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