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## PERIODONTITIS AND RESPIRATORY DISEASES

BY

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### Abstract

*Respiratory diseases causes significant number of deaths and considerable amount of sufferings in human beings. Recent evidence suggests that the oral disorders, particularly the periodontal disease, may influence the development of respiratory infections like bacterial pneumonia and chronic obstructive pulmonary disease. Periodontitis causes microbial and immune imbalances of the lung through several mechanisms like; the inflammatory reaction in the lung was directly caused by periodontal pathogens under periodontitis after inhalation and colonization on the lung; the oral colonization of pneumonia-associated pathogens was promoted by periodontitis status; the respiratory epithelium structure was affected by periodontitis status; imbalances in neutrophils, macrophages, and inflammatory cytokines were caused by periodontitis status. The present article briefly reviews the association between periodontitis and various respiratory diseases.*

## INTRODUCTION.

Periodontitis, also called as a destructive gum disease, ranks among the six most prevalent non-communicable diseases globally.<sup>1,2</sup> Periodontitis is characterized by chronic inflammation of the periodontal tissues primarily resulting from the polymicrobial infection.<sup>3</sup> Recent research confirms that the periodontal infection is likely a risk factor for cardiovascular disease and respiratory disorders. Scientific evidence suggests that untreated moderate periodontitis could potentially impact an individual systemically and may play a role in cardiovascular disease, diabetes, and respiratory disorders.<sup>4</sup> Respiratory diseases contribute significantly to illness and death among human populations. The anatomical connection between the lungs and the oral cavity makes the oral cavity a potential reservoir of respiratory pathogens.

However, the infective agent must overcome the immunological and mechanical defenses to reach the lower respiratory tract. These defense mechanism are highly

effective that in healthy individuals, the distal airways and lung tissue remain sterile, despite the high bacterial counts ( $10^6$  aerobic bacteria and  $10^7$  anaerobic bacteria per milliliter) found in the upper airway.<sup>5</sup>

## COMMON LUNG DISEASES MANIFESTED DUE TO PERIODONTITIS

Periodontitis has the potential to exacerbate systemic diseases, including those affecting the pulmonary system.<sup>6</sup> The periodontal treatment of a patient with pulmonary disease may require alteration depending on the nature of the respiratory problem. Pulmonary diseases range from obstructive lung diseases such as Asthma, Emphysema, Bronchitis, and Acute obstruction to restrictive ventilatory disorders caused by muscle weakness, scarring, obesity, or any condition that could interfere with effective lung ventilation.<sup>7,8</sup> The most common diseases in lung possibly due to periodontitis includes, Pneumonia, Chronic obstructive pulmonary disease, and Asthma.



## PNEUMONIA

Pneumonia arises from various infections affecting the lung tissue, caused by various agents such as bacteria, fungi, parasites, and viruses.<sup>9</sup> Saliva and plaque from patients containing pulmonary pathogens have been shown to increase the risk of aspiration pneumonia.<sup>10</sup>

### TYPES

- Community-acquired
- Hospital-acquired

### COMMUNITY-ACQUIRED PNEUMONIA

It is caused by microorganisms that are present on the oropharynx. Examples of organisms which causes this type of pneumonia are *Streptococcus pneumoniae*, *Haemophilus influenzae*, and anaerobic microorganisms.

### HOSPITAL-ACQUIRED PNEUMONIA

It is also called as nosocomial pneumonia. It is caused by microorganisms that are normally not present on the oropharynx but enters into the oropharynx from the environment. Examples of organisms which causes this type of pneumonia are *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and gram-negative bacilli.<sup>9</sup>

### CHRONIC OBSTRUCTIVE PULMONARY DISEASE

COPD is a chronic systemic inflammatory pulmonary disease characterized by incomplete and progressive airflow restriction, which is related to the abnormal inflammatory response of the lungs to harmful gases or particles.<sup>11,12</sup> The severity of the COPD symptoms worsens with deteriorating periodontal health, and among various periodontal indicators, the plaque index shows the most notable correlation with COPD.<sup>13</sup>

### RISK FACTORS

- Smoking
- Microbial infection
- Environmental pollution
- Diabetes
- Poor socioeconomic status
- Poor oral hygiene

Studies have repeatedly shown that the oral pathogens which could be inhaled into the lungs, potentially leads to lung inflammation. Oral bacteria such as *Aggregatibacter actinomycetemcomitans*, *Capnocytophaga sputigena*, *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Treponema denticola* have been identified in tracheal aspirates from patients experiencing severe acute exacerbations of COPD. This suggests that dental bacteria might contribute to the exacerbation of COPD symptoms.<sup>14</sup>

### ASTHMA

Asthma is marked by recurring episodes of difficulty in breathing, coughing, wheezing, chest tightness, and some pus-

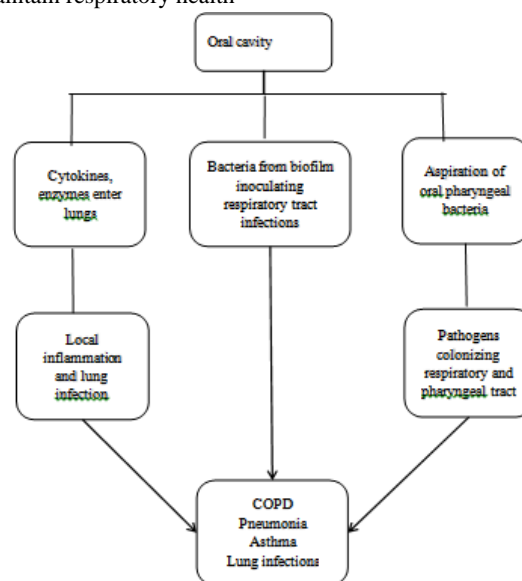
like discharges during the phase of recovery. Salivary IgA serves as a primary defense for the mucosal protection and plays a critical role in preventing periodontitis. Reduced levels of serum IgA in saliva are observed in asthmatic patients, correlating with higher Periodontal Disease Index (PDI) scores indicating increased periodontal destruction. Additionally, gingival IgE concentration is elevated in these patients, further associated with periodontal disease.<sup>15</sup>

### PATHOGENESIS OF PERIODONTITIS AND RESPIRATORY INFECTIONS

Periodontitis primarily involves an inflammatory process mediated by neutrophils. Excessive neutrophil activity in periodontal tissues triggers inflammation characterized by gingival enlargement, gingival bleeding, and eventual loosening of teeth from the gingiva. This process is exacerbated by factors such as bacterial accumulation, food debris, inadequate hygiene, genetic predisposition, and occasionally, immunosuppression. Thus, intrinsic, environmental, and genetic factors collectively contribute to the complexity of periodontitis development.<sup>16</sup>

Respiratory pathology of various respiratory diseases also involves a neutrophil-driven response with various risk factors. These include the accumulation of pulmonary pathogens in the airways, inadequate oral hygiene, inhalation of irritating substances, smoking, and a compromised cough reflex. While upper airways are heavily colonized by oral and nasal bacteria, the lower airways are typically sterile. This sterility is maintained by an intact cough reflex and the mucociliary clearance system, which propel inhaled bacteria and irritants upwards and outwards to the throat.

Additionally, the lower airways are protected by immune defenses such as the surfactant layer containing fibronectin, complement proteins, immunoglobulins, and phagocytic cells, all working together to eliminate foreign particles and maintain respiratory health.<sup>17,18,19</sup>



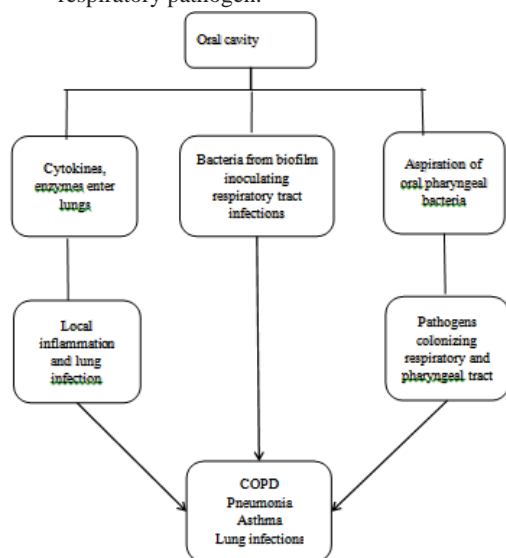
Flowchart showing pathogenesis of oral bacteria causing respiratory infections

## ROLE OF ORAL BACTERIA IN THE PATHOGENESIS OF RESPIRATORY INFECTION

*Actinobacillus actinomycetemcomitans*, *Actinomyces israelii*, *Capnocytophaga* species, *Eikenella corrodens*, *Prevotella intermedia*, *Porphyromonas gingivalis*, and *Streptococcus constellatus* are among the oral bacterial species identified as potential causes of pneumonia and lung abscesses.<sup>[18]</sup>

Scannapieco has proposed several mechanisms to explain the potential role of oral bacteria in the pathogenesis of respiratory infection.<sup>[20]</sup>

- Aspiration of oral pathogens (such as *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans*, etc.) into the lung cause infection,
- Periodontal disease-associated enzymes in saliva may modify mucosal surfaces to promote adhesion and colonization by respiratory pathogens, which are then aspirated into the lung,
- Periodontal disease-associated enzymes in saliva may destroy salivary pellicles on pathogenic bacteria to hinder their clearance from the mucosal surface.
- Cytokines originating from periodontal tissues may alter respiratory epithelium to promote infection by respiratory pathogen.



Flowchart showing pathogenesis of oral bacteria causing respiratory infections

## PERIODONTAL CONDITIONS PREDISPOSING TO LUNG INFECTION

Poor oral hygiene is linked to numerous conditions including dental caries, periodontitis, gum infections, and inflammatory changes that alter the normal flora and chemical composition of the oral cavity. These alterations can lead to tissue reactions within the oral cavity and potentially affect distant sites of the body.<sup>21</sup> While periodontal infections may not directly lead to

systemic lung involvement, it is evident from the preceding discussion that these two conditions are interconnected through shared risk factors, including potentially common pathogenic organisms implicated in both diseases.<sup>6</sup>

## GUIDELINES USED DURING PERIODONTAL THERAPY

1. Identify and refer patients displaying signs and symptoms of pulmonary diseases to their physician.
2. For patients with known pulmonary diseases, collaborate with their physician regarding medications such as antibiotics, steroids, or chemotherapeutic agents, as well as the management of the degree and severity of pulmonary disease.
3. To prevent respiratory depression or distress:
  1. Minimize stress during periodontal appointments. Schedule appointments for patients with emphysema in the afternoon, several hours after sleep, to allow for airway clearance.
  2. Avoid medications that could induce respiratory depression (e.g., narcotics, sedatives, general anesthetics).
  3. Refrain from administering bilateral mandibular block anesthesia, which may exacerbate airway obstruction.
  4. Position the patient to optimize ventilatory efficiency, taking care to prevent physical airway obstruction, maintaining a clear throat, and avoiding excessive periodontal packing.
1. For patients with a history of asthma, particularly those prone to frequent attacks, ensure their inhaler medication is readily available in the dental treatment room, placed conveniently on the countertop.
2. Patients with ongoing fungal or bacterial respiratory infections should only undergo periodontal treatment in emergency situations.

## CONCLUSION

Periodontitis influence progression of lung diseases and may be a cause of oral secretions aspirating into the lungs which can lead to pulmonary illnesses. Along with salivary enzymes, several cytokines from periodontal infections like IL-6 also contribute to the pathophysiology of respiratory infections. The burden of hazardous pulmonary pathogens colonising the oropharynx can be decreased by practicing good oral hygiene, which may lower the risk of respiratory infections in general.

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