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MINI REVIEW

Role of oral health in overall health

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ABSTRACT

Periodontitis is the inflammation of the supporting structures of the teeth. The effect of periodontal inflammation reaches beyond the oral cavity. Periodontal inflammation has a profound effect on systemic health. Systemic conditions like diabetes mellitus, cardiovascular diseases, respiratory disorders, preterm delivery, malignancies, and neurodegenerative diseases like Alzheimer's have been associated with periodontal health status. Inflammation is the key factor that links periodontitis and these systemic conditions. Some of these conditions and periodontitis share a two-way relationship. This review discusses the conditions affected by periodontitis and also emphasizes the importance of maintaining good oral health for the general well-being of an individual.

KEYWORDS

Periodontitis; Periodontal disease; Diabetes; Inflammation; Oral health

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Introduction

Periodontitis or the inflammation of the supporting structures of the teeth is a global oral health problem that eventually leads to the loss of teeth. However, studies have proved that the impact of periodontitis extends beyond the loss of teeth. The association between periodontitis and the general health is well established. The term periodontal medicine refers to the branch of Periodontology that exclusively deals with the relationship between periodontal health and systemic health [1]. The effect of systemic diseases on periodontal health has been established long ago. The role of diabetes in causing periodontitis was discussed by Loe in 1993. He considered periodontitis as the sixth complication of diabetes [2]. Later periodontitis was identified as a risk factor for various systemic diseases [3].

Periodontitis is an inflammatory condition caused by bacteria harbouring dental plaque. The endotoxins released by the gram-negative bacteria of the dental plaque can enter the bloodstream, if the integrity of the epithelium lining the periodontal pocket is broken. The chronic inflammatory state in periodontitis can induce hyperinflammatory response thereby increasing the risk for other systemic inflammatory diseases.

The Mechanism of Association Between Oral Health and Periodontal Health

The chronic bacterial insult in periodontal disease can cause an imbalance in the body's immune response leading to tissue destruction. The tissue destruction facilitates the translocation of bacteria from oral structures to a distant organ, thus exacerbating the existing disease conditions (Table 1). However, an indirect mechanism in which chronic inflammation, as in periodontitis, is causing a systemic hyperinflammatory status has also been suggested [4]. Evidence from the study by Fine N. et al. in 2020 showed increased levels of neutrophils in bone marrow, blood, peritoneum, and colon, indicating the synergistic effect of periodontitis over systemic inflammatory conditions [5].

Table 1. Overview of association between oral health and periodontal health.

Systemic Condition	Impact of Periodontitis	Mechanism
Cardiovascular Diseases	Increases risk of atherosclerosis, coronary artery disease, and heart failure.	• Bacterial endotoxins (e.g., LPS) trigger systemic inflammation. • CRP and IL-6 levels rise, promoting atherosclerotic plaque formation. • Platelet aggregation induced by bacteremia.
Diabetes	Exacerbates insulin resistance, leads to poor glycemic control, and increases type 2 diabetes risk.	• Chronic inflammation elevates IL-6, TNF-α, and CRP, impacting insulin signalling. • Periodontitis worsens HbA1c levels in diabetic patients. • Bacterial translocation to the placenta.

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Negative Pregnancy Outcomes	Linked with preterm birth, low birth weight, preeclampsia, and gestational diabetes.	• Elevated PGE2 induces preterm labour. • Fusobacterium nucleatum is found in the umbilical cord and amniotic fluid.
Respiratory Infections	Associated with pneumonia and exacerbation of chronic obstructive pulmonary disease (COPD).	• Oral pathogens like Fusobacterium travel to the lungs. • Inflammation and cytokine release contribute to lung damage and infections.
Malignancies	Higher risk of oral, oesophagal, pancreatic, and lung cancers.	• *P. gingivalis* promotes carcinogenesis via MMP-9 activation. • Chronic inflammation and immune modulation contribute to tumour progression.
Neurodegenerative Diseases	Implicated in Alzheimer's disease and cognitive decline.	• Lipopolysaccharides from P. gingivalis detected in brain tissue. • Elevated inflammatory cytokines damage neurons. • Association with amyloid plaques.

Oral Health and Cardiovascular Diseases

Inflammation plays a crucial role in the pathogenesis of atherosclerotic plaque. Sustained inflammation in chronic periodontitis can increase the level of systemic pro-inflammatory markers. Bacteremia and persistent pro-inflammatory conditions can induce platelet aggregation and initiate the formation of atherosclerotic plaque [6].

A meta-analysis by Behekar A involving 86,092 patients showed a 1.14-fold rise in the risk of developing coronary artery disease [7]. The migration of bacteria from the oral cavity to distant organs was confirmed by isolating the DNA of common periodontal pathogens from atherosclerotic plaque [8]. It was shown that the level of C-reactive protein, an inflammatory marker, reduces considerably in patients with successful periodontal therapy, thereby lowering the risk of cardiovascular events [9].

Oral Health and Diabetes

There is a three-fold increase in the risk of periodontitis in diabetic patients compared to healthy individuals. The glycemic control of the patient plays a crucial role in the development of periodontitis. Although the studies have focused on type 2 diabetes and periodontitis, evidence also proves the impact of type 1 diabetes on the periodontium [10]. In a case-control study by Lalla E et al., 350 diabetic children were compared with 350 control group. The primary outcomes measured were gingival bleeding and attachment loss which is more common in diabetic children [11].

The two-way relationship between periodontitis and diabetes is well known. Untreated periodontitis can negatively impact a person's blood glucose levels. Ide R et al. conducted a study in which 5848 non-diabetic participants were followed up for seven years. They were divided into those with no pockets, moderate periodontitis, and those with severe periodontitis. However, the author could not prove any relationship between periodontitis and the incidence of diabetes, even though the risk for diabetes increased [12].

Both IL-6 and TNF-α are elevated in diabetes. Increased levels of IL-6 and CRP in non-diabetic patients act as markers for future type 2 diabetes. As periodontitis is also associated with increased IL-6 and CRP levels, it is evident that periodontitis can influence diabetes using inflammatory mediators [13]. A study compared diabetic patients with HBA1C >8% with non-diabetic patients with HBA1C<8%. The outcomes measured were PGE2 and IL-1β, which were significantly higher in diabetic patients, thus proving the bidirectional influence of diabetes and oral health [14].

Oral health and Negative Pregnancy Outcomes

Maternal periodontitis acts as an independent risk factor for low birth weight, preterm labour, preeclampsia, and gestational diabetes. The Periodontal pathogens can reach the placenta through the umbilical cord via vertical transmission. This can interfere with the normal functioning of the placenta. Inflammatory responses can be elicited at the placenta by circulating pro-inflammatory mediators. These pro-inflammatory mediators activate the body's immune system to produce prostaglandin E2 (PGE2). As PGE2 is responsible for uterine contractions, high levels can trigger preterm labour [4]. *Fusobacterium nucleatum* is one of the most commonly isolated periodontal pathogens from the umbilical cord and amniotic fluid. Animal studies have shown growth restriction in rats following exposure to lipopolysaccharide of *P. gingivalis* [8].

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Periodontitis and Respiratory Tract Infections

An unhealthy oral environment can cause respiratory tract infections and pneumonia. Periodontitis patients have a three-fold rise in the risk of developing nosocomial pneumonia than healthy individuals [8]. Animal studies have shown that *P. gingivalis* can cause inflammatory reactions and pro-inflammatory cytokine production around the lungs in rat models [15]. It is proposed that pulmonary infections can occur as a result of bacteria leaking from the dental plaque to saliva and finally reaching the lungs [6]. The role of oral pathogen Fusobacterium in causing lung infections is ascertained by isolating *F. necrophorum* from 20.5% of patients with acute sore throats [16]. Colonization of pathogenic bacteria and the progression of respiratory diseases are further enhanced by the flow of pro-inflammatory molecules and enzymes produced as a result of periodontitis, into the lungs [6].

Oral Health and Malignancy

There is plenty of evidence confirming the association between periodontal pathogens and cancer. A significantly higher number of *P. gingivalis* was isolated from the mucosa of oral and oesophagal squamous cell carcinoma patients than from healthy mucosa. A study conducted in one million randomly selected insurance cases showed a higher cancer risk in periodontitis patients than in gingivitis patients [6]. In a meta-analysis by Yao Q-W et al., 1,191 oral cancer patients were compared with 1,191 healthy patients. The study showed that periodontitis is significantly associated with oral [17]. Apart from oral cancer, periodontitis is also found to be associated with head, neck, lung, and pancreatic cancers. It has shown that the innate immune response elicited from the direct interaction of periodontal pathogens with oral epithelial cells can mediate carcinogenesis. *P. gingivalis* can induce the expression of MMP-9 which in turn can cause metastasis of oral cancer. As there is a significant association between oral pathogens and malignancies, their role in serving as a biomarker for early detection of cancer needs to be researched further [6].

Oral Health and Alzheimer's Disease

Alzheimer's disease is a neurodegenerative disorder characterized by permanent impairment of cognitive functions of the brain caused by the deposition of amyloid plaques and hyperphosphorylated tau proteins in the brain. It is believed that there is a two-directional relationship between periodontitis and Alzheimer's disease. Alzheimer's disease is characterized by significantly higher levels of inflammatory cytokines produced by activated glial cells. The elevated levels of inflammatory mediators link periodontitis and Alzheimer's disease [6]. Isolation of lipopolysaccharides of *P. gingivalis* and *T. denticola* and bacteria such as *T. denticola* and *C. pneumoniae* from the brains of Alzheimer's disease patients points out the involvement of oral pathogens and their virulence factors in brain inflammation [18,19].

Effect of periodontal treatment on General Health

Periodontitis can be controlled by maintaining proper oral hygiene, controlling the risk factors, and performing supra and sub-gingival plaque removal. An investigation conducted in 14 chronic periodontitis patients has shown elevated levels of systemic inflammatory markers immediately following periodontal therapy. However, improvements in periodontal disease and endothelial function were observed at 3 months and 6 months after vigorous periodontal treatment [20]. A meta-analysis of 47 randomized controlled trials was conducted to assess the impact of periodontitis treatment on systemic health. The study observed a significant reduction in CRP, interleukin 6, and fasting glucose levels. The periodontal treatment showed a positive impact on adverse pregnancy outcomes. This evidence suggests that periodontal therapy can be considered a non-pharmacological therapy to improve systemic conditions triggered by inflammatory processes [21].

Conclusion

Research has undoubtedly proven the impact of periodontal disease on overall health. The chronic inflammation associated with periodontitis can trigger systemic inflammatory reactions which in turn increase the risk or aggravate already existing conditions like cardiovascular diseases, diabetes, respiratory disorders, etc. In addition, poor oral conditions can negatively influence neurodegenerative diseases of the brain, cancers, and adverse pregnancy outcomes. Although periodontal treatment can lead to an acute rise in inflammatory markers, in the long term, it has a positive effect on systemic health. Hence it is important to maintain oral health for overall well-being. Further studies need to be conducted to confirm the role of periodontal pathogens as a biomarker for malignancies and to evaluate how periodontal treatments can be effectively utilized as a non-pharmacological therapy to control systemic inflammation.

Disclosure Statement

No potential conflict of interest was reported by the author.

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