Periodontal Disease and the Link to Systemic Diseases

Aims: To provide the dental professional with an understanding of the potential link between gum disease and systemic health.

Objectives: On completion of this verifiable CPD article the participant will be able to demonstrate, through completion of a questionnaire, the ability to:

- Demonstrate understanding of the original focal infection theory.
- Demonstrate an understanding of the role of oral bacteraemia in systemic health.
- Demonstrate the ability to understand, and therefore be able to educate patients, on the potential link between gum disease and heart disease; pregnancy complications; diabetes; dementia; and, pulmonary disease.

Introduction

Miller originally published his "focal infection theory" in 1891 which became popular in the beginning of the 20th century.[1] The focal infection theory suggested that many human diseases could be linked to other parts of the body, such as the oral cavity. At the time, the theory was not supported by sound scientific evidence. However, before it was discredited, it led to many teeth being extracted prophylactically without evidence of infection.[2]

Recent progress in the classification and identification of oral microorganisms and the realisation that certain microorganisms are usually only found in the oral cavity have opened the way for a more realistic assessment of the importance of oral focal infection.[2] Emerging evidence now implicates periodontal infections (gum disease) as one of several important factors that exert negative effects on systemic health.[3]

In the course of their work, Dental Care Professionals may have to explain the potential connection between periodontal disease and systemic health to patients. This article aims to provide the dental professional with an understanding of the potential link between gum disease and cardiovascular disease, pregnancy complications, diabetes, dementia and pulmonary diseases. Further research is available from the links at the end of this article.

Potential Associations between Periodontal Infections and Adverse Systemic Outcomes

The following diagram shows the potential associations between periodontal infections and adverse systemic outcomes.[4]

Several different pathways for the passage of periodontal pathogens and their products into the circulation have been suggested and are currently the subject of extensive research.[5] However, it has been suggested, that for most of these associated conditions, the connection begins with the entry of bacteria into the blood stream (bacteraemia) from the infected periodontal tissues.[3]

Bacteria infecting periodontal pockets easily enter the blood stream through ulcerated periodontal pocket walls. The most recent Adult Dental Health survey found that gingival bleeding was present in just over half of the patients who said they attended the dentist within the past 12 months.[6] Patients may report “bleeding gums” or a clinician may note bleeding on probing (fig.1). The presence of these factors strongly suggests that there is sufficient gingival inflammation to cause pocket wall ulceration which could lead to repeated doses of bacteraemia throughout the day.

Fig 1. The presence of gingival inflammation may lead to repeated doses of bacteraemia

Cardiovascular Disease

Cardiovascular disease (CVD) - also known as heart and circulatory disease causes more than a quarter of all deaths in the UK. The 2024 British Heart Foundation Statistics state that there are around 7.5 million people living with heart and circulatory diseases and estimates that more than half of us will get a heart or circulatory problem in our lifetime.[7] CVDs are a group of diseases that include congestive heart failure, coronary artery disease (including atherosclerosis and myocardial infarction), valvular heart disease and stroke.[2]

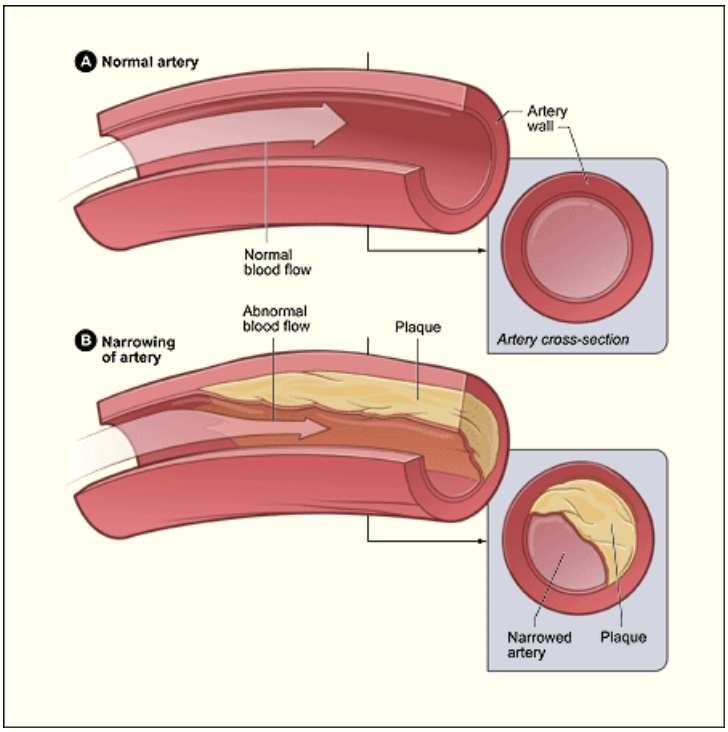
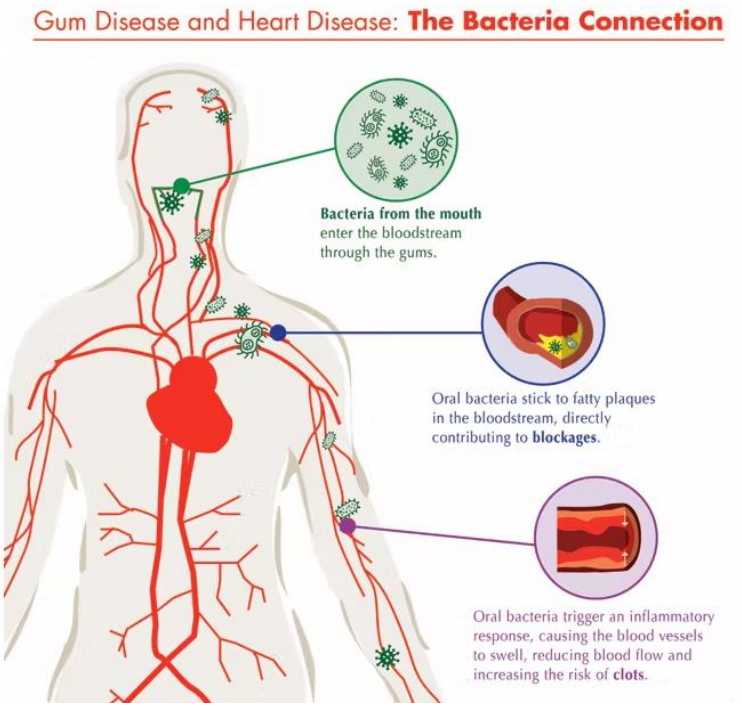


Fig.2 Diagram showing atherosclerosis (narrowing of the artery) in CVD

It has been reported that people with gum disease are almost twice as likely to have CVD than people without gum disease. A major component of CVD is characterised

by the deposition of atherosclerotic plaques (fig.2). Atherosclerosis can occur over a period of time when the arteries naturally begin to harden and get narrower. This process can be accelerated by plaque build-up (cholesterol, fatty substances) in the inner linings of artery. If a piece of atheroma from the hardened artery breaks away, it can cause a blood clot to form. A stroke occurs if a blood clot restricts the flow of blood to the brain. If this blood clot blocks the coronary artery it may lead to a myocardial infarction.[7]

Periodontitis and cardiovascular diseases are both inflammatory conditions. Recent epidemiological studies have associated the effects of periodontitis on cardiovascular disease (CVD) progression.[8] There are a number of mechanisms by which oral infections may contribute to CVD.[5] The host response to the presence of periodontal pathogens may trigger the production of inflammatory mediators, which can accelerate the progression of pre-existing atherosclerotic plaques. Also, many studies have demonstrated the ability of periodontal pathogens to induce platelet aggregation and the formation of atheroma.[2]



Gum Disease and Heart Disease

In 2023, The European Federation of Periodontology and the European arm of the World Organisation of Family Doctors published a consensus report on the association between periodontal diseases, diabetes and respiratory diseases. The report stated that, “Several systemic reviews conducted in the last 10 years have demonstrated a higher prevalence of coronary artery disease and risk of myocardial infarction and other coronary events in patients with diagnosed periodontitis or more severe periodontitis.” [9]

One systematic review carried out by Dietrich et al., reviewed twelve cohort and case control studies.[10] They concluded that there was evidence that patients with

periodontal disease had an increased risk of atherosclerotic CVD. However, the association may not apply to all groups of the population.

A comprehensive review was performed by the American Heart Association working group[11] who concluded that extensive review of the literature "indicates that periodontal disease is associated with atherosclerotic CVD independent of known confounders." However, they acknowledge that the studies do not "demonstrate that periodontal disease is a cause of atherosclerotic CVD or that therapeutic interventions of periodontal disease will prevent heart disease, strokes, or modify the clinical cause of atherosclerotic CVD." They further go on to suggest that although a contribution of periodontal disease to atherosclerotic CVD is biologically plausible, periodontal disease and CVD share multiple risk factors such as tobacco use, diabetes mellitus and age.

A Cochrane Review which was published in December 2019, aimed to investigate the effects of periodontal therapy for primary or secondary prevention of CVD in people with chronic periodontitis. Randomised controlled trials were included that compared active periodontal therapy to no periodontal treatment or a different periodontal treatment. The authors concluded that "there is no reliable evidence available regarding secondary prevention of CVD in people diagnosed with chronic periodontitis and CVD. Further trials are needed to reach conclusions about whether treatment for periodontal disease can help prevent occurrence or recurrence of CVD."[12] However, the recent 2023 joint consensus report states that there is clear evidence on the effect of periodontal therapy on surrogate markers of CVD. There is a significant effect of periodontal treatment in reducing low-grade inflammation."[9]

It is advised that oral health practitioners should advise patients with periodontitis that their risk of CVD, such as myocardial infarction or stroke, is higher.[9] It is also important to consider that there are many risk factors for CVD and to acknowledge that there are still some gaps in scientific understanding. The recent 2023 joint consensus report organised by the European Federation of Periodontology and the World Health Federation contains a lot of the updated epidemiological evidence and can be accessed at the end of this article in the further reading section.

Pregnancy Complications and Outcomes

The latest Preterm birth statistics from the World Health Organisation, estimated that 13.4 million babies were born preterm in 2020 (before 37 completed weeks of gestation).[13] The presence of infection, particularly in the cervical area of the uterus, increases the risk of delivering a preterm low- birth weight baby.

The World Health Organisation state that “low birth weight rate in a population is a good indicator of a public health problem that includes long-term maternal malnutrition, ill health, and poor health care. On an individual basis, low birth weight is an important predictor of new-born health and survival.” Low birth weight is defined as birth weight of less than 2,500g.[13]

One suggested explanation is that endotoxin from gram-negative bacteria enters the circulation at high enough levels to stimulate production of inflammatory mediators, such as prostaglandin E_2(PGE_2), by the amnion. PGE_2 and other inflammatory mediators are potent inducers of labour.[3]

The British Dental Health Foundation state that “Pregnant women who have gum disease may be over three times more likely to have a baby that is premature and so has a low birth weight. There is a one in four chance that a pregnant woman with gum disease will give birth before 35 weeks”.[14]

In 2021, Pockpa et al.[15] conducted a review of two decades of research into periodontal diseases and adverse pregnancy outcomes. Of the 633 articles identified, 232 were selected for analysis. They concluded that, “the majority of studies highlighted a statistically significant association between periodontal diseases and preterm birth, low birth weight, preterm low birthweight, preeclampsia, and other pregnancy complications, such as, preterm prelabour rupture of membranes.”

A review of randomised controlled trials published in the European Federation of Periodontology was carried out to evaluate the importance of periodontal disease treatment during pregnancy. The authors concluded that although non-surgical periodontal therapy during pregnancy is safe, it does not reduce the incidence of adverse pregnancy outcomes such as preterm birth and low birth weight. However, periodontal treatment may reduce rates of these outcomes in certain cases – for example, in women who are at high risk of pregnancy complications or who have a better response to periodontal treatment. The authors stated that, “When gingivitis or periodontitis are diagnosed, periodontal treatment should be provided. Periodontal therapy will improve the periodontal condition and therefore the overall health of pregnant women.” They also added that, “in terms of affecting adverse pregnancy outcomes, it may be more effective to provide women with periodontal treatment before they conceive.”[16]

Regardless of the fact that more research may be needed in this area, it is important that expectant mothers are informed of their oral health status and given preventative advice. In addition, because non-surgical periodontal therapy during the second trimester of pregnancy has been shown to be safe, it is highly recommended that treatment of periodontal infections should be part of prenatal care programmes.[3]

Diabetes Mellitus

Diabetes is a long-term (chronic) condition caused by too much glucose in the blood. It is estimated that over 5.6 million people in the UK are living with diabetes.[17]

Epidemiological studies confirm that diabetes is a significant risk factor for periodontitis, and the risk of periodontitis is greater if glycaemic control is poor; people with poorly controlled diabetes are at an increased risk of periodontitis and alveolar bone loss.[18] In addition, a two-way relationship is suggested, where the presence of periodontal disease may induce a state of chronic systemic inflammation which in turn can exacerbate resistance to insulin.

Glycaemic control is a key issue in the care of people with diabetes mellitus. Research evidence has suggested that treating gum disease in people with diabetes may assist in lowering blood sugar levels. A review of epidemiologic observational evidence concluded that there is a small body of evidence that supports significant adverse effects of periodontal disease on glycaemic control, diabetes complications, and the development of type two diabetes. However, they also acknowledged the limitation of the included studies and suggested that further longitudinal studies are warranted. [19] In addition, a Cochrane review also concluded that there was “low quality evidence” of improvement in metabolic control in people with diabetes after treating periodontal disease. However, there is insufficient evidence to demonstrate that this is maintained after 4 months and suggested that “ongoing professional periodontal treatment will be required to maintain clinical improvements beyond 6 months.” They also acknowledged the need for further carefully conducted studies using a larger number of people.[20]

A systematic review and meta-analysis of cohort studies was published in 2021 and concluded that there was a “positive bidirectional association between periodontal disease and diabetes mellitus and thus, underlines the need for screening of patients with periodontitis regarding diabetes mellitus and vice versa.” They acknowledged that main limitation of the study is the high unexplained heterogeneity between the studies including the different assessment methods of the disease diagnosis.[21]

Since a modest improvement in glycaemic control can have substantial benefits in reducing complications, it is essential that diabetics have regular oral health assessments. Patients should be educated on the two-way relationship between oral health and diabetes. A recent systematic review of 24 studies, considering 8,693

patients aimed to evaluate the level of knowledge of the bidirectional relationship between diabetes mellitus and periodontal disease. The results of the systematic review showed that less than half of people with diabetes have knowledge about their risk for periodontal disease.[22] This demonstrates the importance of the role of the dental team in educating patients.

Pulmonary Diseases

Periodontal infections have been implicated as important in the development of a number of pulmonary diseases including:

- Aspiration pneumonias
- Ventilator-associated pneumonias
- Chronic obstructive pulmonary disease[3]

Pathogenic bacteria that can cause respiratory disease to colonise the dental plaque biofilm on the teeth. They can then be shed in high numbers into the oral secretions from inflamed gingiva. These secretions may then be aspirated into the lower airway to contribute to infection and inflammation in the lung (fig.3). It is suggested that periodontal disease may be a risk factor for chronic obstructive pulmonary disease.[23]

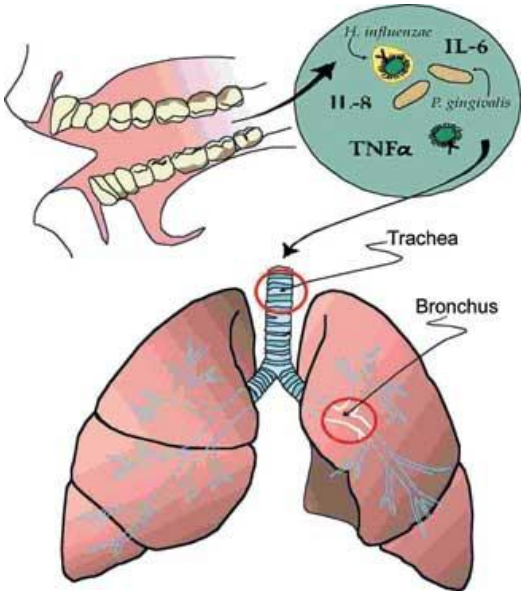


Fig. 3 Bacteria from the oral cavity may contribute to infection and inflammation in the lung

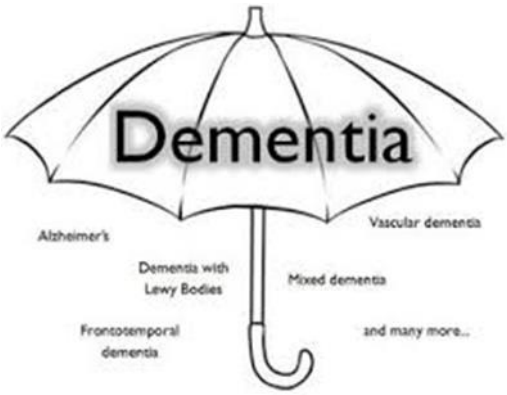
A literature review published in 2017 aimed to assess the relationship between periodontitis and respiratory diseases. The review included studies conducted between 1994 and 2015 and the authors concluded that there “is association between periodontitis and respiratory diseases such as chronic obstructive pulmonary disease and pneumonia. It was found that periodontitis is associated with respiratory diseases due to poor oral hygiene and low immunity state.”[24]

Several risk factors have been associated with more severe COVID-19 such as age, sex, obesity, and the presence of underlying health conditions. The results of a recent

systematic review and meta-analysis published in 2023, suggests a significant association between periodontitis and poor COVID-19 outcomes. However, further research is required. [25]

This again highlights the importance of regular oral health assessments, oral hygiene education and treatment for periodontal disease.

Dementia



Dementia itself is not a disease but is caused by many different diseases. The term 'dementia' is used to describe the symptoms that are caused by these diseases. Such symptoms include memory loss, confusion and personality change. Alzheimer's disease is the most common cause, but other dementias include vascular dementia, dementia with lewy bodies and frontotemporal dementia.[26]

In the UK it is estimated that around 944,000 people are living with dementia, and this number is projected to rise to 1.6 million by 2050. 65% of the 944,000 people living with dementia in the UK are women. It is estimated that 1 in 11 people over the age of 65 have dementia in the UK and that one in two of us will be affected by dementia either by caring for someone with the condition, developing it ourselves, or both. [26]

A small observational study published in March 2016 concluded that gum disease is associated with an increase in cognitive decline in Alzheimer's disease, possibly by mechanisms linked to the body's inflammatory response.[27] In addition, a 2019 study conducted by Dominy et al.,found that "Porphyromanas gingivalis, the keystone pathogen in chronic periodontitis, was identified in the brain of Alzheimer's disease patients. They concluded that "the findings of this study offer evidence that Porphyromonas gingivalis and gingipains in the brain play a central role in the pathogenesis of Alzheimer's disease, providing a new conceptual framework for disease treatment."[28]

One explanation is that bacteria from the gums may enter the brain through immune system cells or through cranial nerves, however, research has shown that people with dementia experience significantly poorer gingival health and significantly heavier gingival bleeding than those without the condition,[29] meaning that they are more likely to have periodontal disease.

A review published in 2020, aimed to take evidence from the latest epidemiological studies to see if there was an association between periodontal health/treatment and cognitive impairment. The authors conducted a PubMed search of literature published between January 2015 and September 2019 and selected 15 studies. They concluded that, “the latest evidence suggests that prevention of periodontal disease may facilitate prevention of cognitive impairment; however, further interventional research should be conducted to obtain definite conclusions regarding the causal relationship between periodontal treatment and impaired cognition.”[30]

In 2021, a meta-analysis was carried out to assess the effect of periodontitis on dementia and cognitive impairment. A literature search was carried out and 20 observational studies were included. The meta-analysis concluded that “there was an association between periodontitis and cognitive impairment, and moderate or severe periodontitis was a risk factor for dementia. Additionally, the deterioration of periodontal status was observed among dementia patients.” Again, the study recognised the importance of further well-designed studies being necessary to confirm the relationship between periodontal disease and dementia/cognitive impairment.[31]

In 2023 a systematic review was carried out to investigate the association between periodontal disease and cognitive impairment in adults. Six cohort studies, three cross-sectional studies and two case-control studies met the inclusion criteria. The results from the included studies showed that “chronic periodontitis patients with at least eight years of exposure are at higher risk of developing cognitive decline and dementia.” Nonetheless, they concluded that “the mechanisms responsible for the association between periodontitis and dementia are still unclear and warrant further investigation.”[31]

It is clear that dental professionals need to encourage the patient to maintain good oral health and educate patients on the potential link between gum disease and cognitive impairment. In addition, the Alzheimer’s Society recognise the importance of good oral health for the importance of health and wellbeing and that maintaining oral health will also bring benefits in terms of self-esteem, dignity, social integration, and nutrition.

Conclusion

There is a long standing and well accepted principle that good oral health is an integral component of good general health.[5] Preliminary data suggests that periodontal diseases have adverse effects on systemic health and a scientifically based understanding of how oral health may pose a risk for certain systemic diseases is developing.[3] There is now good evidence for periodontitis being associated with various systemic diseases, however there is still a lack of evidence for a causative role and further research is required.[4]

Personal Development Plan and Reflective Learning

This CPD is linked to the following GDC Enhanced CPD Development Outcomes:

A. Effective communication with patients, the dental team and others across dentistry, including when obtaining consent, dealing with complaints, and raising concerns when patients are at risk.

C. Maintenance and development of knowledge and skill within your field of practice.

Reflective learning is now a requirement of the GDC Enhanced Professional Development Scheme. As such, you will now need to answer some reflective learning questions, before your certificate is generated

Please remember that you need to fill this in on completion of the exam but you can also update this at any time from your CPD log. If you take a few moments to write your reflection on completion, you will have fulfilled the Enhanced CPD requirements.

Further Reading

BDJ Team (2015) Systemic diseases chronic periodontitis has been linked to

Dominy, S et al. (2019) Porphyromonas gingivalis in Alzheimer's disease brains: Evidence for disease causation and treatment with small-molecule inhibitors

Paul, P et al. (2021) Inflammation in Periodontal Disease: Possible Link to Vascular Disease

Association between periodontal diseases and cardiovascular diseases, diabetes and respiratory diseases: Consensus report of the Joint Workshop by the European Federation of Periodontology (EFP) and the European arm of the World Organization of Family Doctors 2023

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