

# Impact of periodontitis on systemic health and on implants

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## Introduction

Mouth and health go hand in hand. After all, the mouth is the entrance gate to our body. Food enters through there and our teeth are the instruments to chew this food so that the food components we need can also be effectively released. There is a need for a healthy mouth, to keep a healthy body!

After all, infections in the mouth have an enormous impact on the rest of our general health. Biting and chewing can continuously force oral bacteria into our bloodstream, where they move through the body, and can cause damage in several organs (e.g. kidneys, heart, lungs and brain).

Thousands of scientific articles have already been published about this topic: on 1 August 2024, there were 3,966 hits combining both topics on PubMed! However, this phenomenon is still insufficiently known to the public and even to many dentists and physicians.<sup>1</sup>

Meanwhile, periodontitis, the severe gum infection that damages the soft tissue and destroys the tissues that support the teeth, has been linked to several systemic diseases. This connection is largely due to the inflammatory nature of periodontitis which is accompanied by large quantities of highly pathogenic bacteria (eg. *Porphyromonas gingivalis*, *Prevotella intermedia* and *Fusobacterium nucleatum*). These pathogens have farreaching effects beyond the oral cavity because they strongly trigger the immune response.<sup>2</sup>

The local consequence is limited to tissue destruction: the inflammatory response leads to the destruction of gum tissue, periodontal ligament and alveolar bone.<sup>3</sup>

The systemic impact of these focal infections is however often neglected although the scientific literature is very clear: periodontitis undeniably causes or worsens several systemic health problems.<sup>4</sup>

This first article in a series of two, will focus on six key points about the relationship between periodontitis and

systemic diseases. The second article will come up with six more associations between periodontal disease and systemic diseases.

## 1. Cardiovascular disease

Cardiovascular disease (CVD) encompasses a range of heart and blood vessel disorders, including coronary artery disease, hypertension, and stroke.

Periodontitis and cardiovascular disease are interconnected through various mechanisms, involving systemic inflammation, endothelial dysfunction, and shared risk factors.

The inflammation caused by periodontitis can contribute to the buildup of plaques in arteries (atherosclerosis), leading to heart attacks and other cardiovascular events. Moreover, periodontitis increases the risk of a heart attack by two times.<sup>5</sup> The risk of a stroke or TIA is even three times higher when periodontitis is present.<sup>6</sup> Existing heart problems are also aggravated by the presence of oral infections.

**The four main connections between periodontitis and cardiovascular disease are:**

- 1. Systemic inflammation:** periodontitis can cause an increase in systemic inflammatory markers like C-reactive protein (CRP), which is also linked to atherosclerosis.
- 2. Endothelial dysfunction:** bacteria and inflammatory mediators from periodontal disease can enter the bloodstream, leading to endothelial dysfunction, a precursor to atherosclerosis.
- 3. Bacterial translocation:** oral bacteria from periodontitis can enter the bloodstream, contributing directly to the formation of arterial plaques.
- 4. Immune response:** the immune response to periodontal infection can exacerbate inflammatory processes in the arteries—chronic inflammation is a key factor in the development of atherosclerosis.

Cardiovascular disease and periodontitis have several major shared risk factors: smoking, diabetes, age, genetics and diet.<sup>7</sup>

The obvious link between the two diseases invites patients and practitioners to some clinical implications:

- 1. Early screening:** regular dental check-ups and periodontal assessments help identify individuals at risk for CVD.
- 2. Structured preventive care:** good oral hygiene and periodontal therapy reduces systemic inflammation, lowering the risk of CVD.
- 3. Promoting integrated care:** serious collaboration between dental and medical professionals improves overall patient health outcomes.

## 2. Diabetes

Diabetes is a chronic metabolic disorder characterised by high blood glucose levels due to either insufficient insulin production (Type 1 diabetes) or insulin resistance (Type 2 diabetes).

There is a bidirectional relationship between periodontitis and diabetes. Not only are people with diabetes more susceptible to periodontitis, but periodontitis can also make it more difficult to control blood sugar levels, thereby exacerbating diabetes.<sup>8</sup> More than 90% of periodontitis patients are at risk of diabetes. In this bidirectional relationship, both conditions can influence the onset and progression of the other.

**Impact of diabetes on periodontitis:**

- 1. Impaired immune response:** hyperglycemia can impair the immune system, making it harder to fight off bacterial infections in the gums.
- 2. Increased inflammation:** high blood sugar levels increase the inflammatory response, exacerbating gum disease.
- 3. Poor healing:** diabetes can slow down the healing process of gum tissue, worsening periodontitis.<sup>9</sup>

**Impact of periodontitis on diabetes:**

- 1. Increased blood sugar levels:** chronic inflammation from periodontitis can increase insulin resistance, making blood sugar control more difficult.
- 2. Systemic inflammation:** periodontitis can elevate systemic inflammatory markers, which can negatively affect blood sugar regulation.
- 3. Complications management:** poor oral health can complicate the management of diabetes, leading to a vicious cycle of worsening health.

In these processes there are three mechanisms of interaction. Both conditions increase the production of inflammatory cytokines such as TNF- $\alpha$  and IL-6, which contribute to insulin resistance and tissue destruction. Furthermore, advanced glycation end-products (AGEs) which are elevated in diabetes, can accumulate in periodontal tissues, promoting inflammation and tissue damage there.<sup>10</sup> Finally, increased oxidative stress in both dia-

betes and periodontitis can lead to further tissue damage and complications.

Due to this two-way relationship, similar clinical recommendations can be highlighted as for CVD:

- 1. Screening and monitoring:** for diabetics patients regular dental check-ups are crucial to detect and manage periodontitis early. Whereas for periodontitis patients' blood glucose monitoring can help identify undiagnosed diabetes or prediabetes.
- 2. Integrated care:** dentists and other healthcare providers should work together to manage both conditions. Furthermore, educating patients on the importance of oral hygiene and diabetes control is vital for overall health.
- 3. Preventive and therapeutic strategies:** regular brushing, flossing, and professional cleanings can help prevent periodontitis. Maintaining optimal blood sugar levels through diet, exercise, and medication can reduce the risk of periodontal disease. Medications and therapies to reduce inflammation can benefit both conditions.

## 3. Respiratory diseases

Respiratory diseases include a range of conditions affecting the lungs and airways, such as chronic obstructive pulmonary disease (COPD), pneumonia, and asthma. Chronic periodontitis has been linked to an increased risk of these respiratory conditions. The latter is thought to occur due to the aspiration of bacteria from the mouth into the lungs. A similar link has also been demonstrated with the severity of COVID-19 infections.<sup>11</sup>

The relationship between respiratory disease and periodontitis involves shared mechanisms such as inflammation and bacterial infection.

The interconnection between both pathologies is based on:

- 1. Bacterial aspiration:** bacteria from the oral cavity can be aspirated into the lower respiratory tract, leading to infections such as pneumonia. This is particularly a risk in elderly patients and those with weakened immune systems.<sup>12</sup>
- 2. Systemic inflammation:** periodontitis can increase systemic inflammatory markers (e.g. IL-6, TNF- $\alpha$ ) into the bloodstream, which can exacerbate chronic inflammatory conditions like COPD and asthma.<sup>13</sup>
- 3. Immune response:** the immune response to periodontal infection can weaken the body's ability to fight off respiratory pathogens.
- 4. Oral hygiene:** poor oral hygiene associated with periodontitis can increase the risk of respiratory infections due to higher levels of pathogenic bacteria in the mouth.

The same clinical recommendations as for periodontitis-diabetes/CVD are also applicable here: good oral hygiene,

regular dental check-ups, interprofessional dental–medical collaboration and early screening.

The therapy consists of anti-inflammatory treatments (managing periodontal inflammation reduces systemic inflammation and potentially improve respiratory health) and eventual antibiotic therapy (when the bacterial infection is significant, targeted antibiotics may be necessary).

#### 4. Pregnancy

Pregnancy is of course not a disease, but it involves significant physiological changes that can influence oral health. Pregnant women with periodontitis are at a higher risk of adverse pregnancy outcomes because inflammatory mediators from periodontitis may affect the fetal environment.

There are three main types of impact from periodontitis on pregnancy:

- 1. Preterm birth:** periodontitis has been linked to an increased risk of preterm birth (delivery before 37 weeks). The inflammatory mediators produced in response to periodontal infection can enter the bloodstream and potentially trigger premature labor.<sup>14</sup>
- 2. Low birth weight:** inflammatory cytokines and bacterial endotoxins from periodontitis can affect the placental function, potentially leading to low-birth-weight babies.<sup>15</sup>
- 3. Preeclampsia:** periodontitis has been associated with an increased risk of preeclampsia, a pregnancy complication characterised by high blood pressure and damage to other organs, often the kidneys.

Furthermore, there are also three sorts of impact from pregnancy on periodontitis:

- 1. Pregnancy gingivitis:** increased hormone levels can cause gums to become more sensitive and prone to inflammation, known as pregnancy gingivitis. If left untreated, it can progress to periodontitis.<sup>16</sup>
- 2. Exacerbation of existing periodontitis:** hormonal changes during pregnancy can exacerbate existing periodontal disease due to increased blood flow to the gums and an altered immune response.<sup>17</sup>
- 3. Altered oral hygiene:** morning sickness and changes in diet can lead to increased plaque accumulation, affecting periodontal health.<sup>18</sup>

The key aspects of these interactions include:

- 1. Hormonal changes:** elevated levels of estrogen and progesterone. These hormones can enhance the inflammatory response in gum tissues.
- 2. Immune system alterations:** modulated immune response to accommodate fetal development. These changes in the immune system can alter the host response to periodontal pathogens.

**3. Inflammatory mediators increase:** cytokines and prostaglandins produced during periodontal inflammation can affect pregnancy outcomes.

**4. Increased blood volume:** enhances tissue sensitivity and bleeding.

The clinical advice consists of: pre-conception care, regular dental visits, oral hygiene education, professional cleaning, good oral hygiene practices, nutritional guidance and management of morning sickness.

#### 5. Rheumatoid arthritis

RA is an autoimmune disorder characterised by chronic inflammation of the joints, leading to pain, swelling, and eventual joint destruction. There is evidence suggesting a link between periodontitis and rheumatoid arthritis. Both share several pathogenic mechanisms and risk factors. The more severe the periodontitis, the more severe the rheumatism. Specific oral bacteria are responsible for this.

Emerging evidence suggests a bidirectional relationship between these diseases.

There are four shared mechanisms between rheumatoid arthritis and periodontitis:

- 1. Chronic inflammation:** both conditions involve chronic inflammation driven by an overactive immune response.
- 2. Cytokine production:** elevated levels of pro-inflammatory cytokines like TNF- $\alpha$ , IL-1, and IL-6 are common in both RA and periodontitis.
- 3. Genetic predisposition:** certain genetic factors, such as shared susceptibility loci, may predispose individuals to both conditions.
- 4. Autoimmunity:** the presence of autoantibodies like rheumatoid factor (RF) and anti-citrullinated protein antibodies (ACPAs) is common in RA and may be found in periodontitis patients.

The impact of periodontitis on RA deals not only with increased inflammation (periodontal infection can exacerbate systemic inflammation, potentially worsening RA symptoms), but also with bacterial translocation (oral bacteria, particularly *P. gingivalis*, can enter the bloodstream and contribute to RA pathogenesis through molecular mimicry and citrullination of proteins).<sup>19</sup>

Meanwhile, the impact of RA on periodontitis bears with an altered immune response (the dysregulated immune response in RA can impair the body's ability to control periodontal infections) and the effects of medication (immunosuppressive medications used to treat RA can affect oral health, either by increasing susceptibility to infections or causing dry mouth, which can exacerbate periodontitis).<sup>20</sup>

Clinical implications comprise again: screening and diagnosis (regular periodontal assessments for RA patients—individuals with severe periodontitis should be evaluated for signs and symptoms of RA), integrated care (rheumatologists and dentists should collaborate) and preventive and therapeutic strategies (oral hygiene, professional dental care and anti-inflammatory treatments).

## 6. Chronic kidney disease

CKD is a progressive loss of kidney function over time, which can eventually lead to kidney failure. It is often associated with other comorbidities, such as cardiovascular disease and diabetes. Periodontitis has been associated with an increased risk of chronic kidney disease. Inflammatory processes and bacterial infections common to both conditions might play a role in this connection.

The combination of periodontitis and kidney disease leads to increased mortality due to the increase in the total inflammatory burden.

Chronic kidney disease (CKD) and periodontitis are interconnected through shared risk factors, inflammatory mechanisms, and potential bidirectional influences.

**The shared mechanisms between these two diseases are based on:**

- 1. Chronic inflammation:** both CKD and periodontitis involve chronic inflammatory responses. Periodontitis can contribute to systemic inflammation, exacerbating CKD.
- 2. Immune dysregulation:** CKD can impair the immune system, making individuals more susceptible to infections, including periodontal disease.
- 3. Common risk factors:** conditions like diabetes and cardiovascular disease are risk factors for both CKD and periodontitis.

**Periodontitis has a three-way influence on CKD:**

- 1. Systemic inflammation:** periodontal infection can increase systemic inflammatory markers such as C-reactive protein (CRP), which can worsen kidney function.
- 2. Bacterial translocation:** oral bacteria and their by-products can enter the bloodstream, potentially affecting the kidneys and contributing to the progression of CKD.
- 3. Endothelial dysfunction:** chronic inflammation from periodontitis can lead to endothelial dysfunction, a factor in the progression of CKD.<sup>21</sup>

**In the other direction, CKD has a trilateral impact on periodontitis:**

- 1. Reduced immune function:** CKD impairs the immune response, increasing susceptibility to periodontal infections.

**2. Altered oral environment:** CKD and its treatments can alter the oral environment, making it more conducive to periodontal disease. For instance, reduced salivary flow can lead to increased plaque accumulation.

**3. Medication side effects:** medications for CKD, such as immunosuppressants and antihypertensives, can affect oral health and increase the risk of periodontal disease.<sup>22</sup>

The clinical implications are similar as for the other systemic conditions: screening and diagnosis, integrated care and preventive and therapeutic strategies.

## Summary

The effect of periodontitis is not limited to the oral cavity. Periodontitis is not only causing tooth loss, but it has also a far-reaching impact on general health. Periodontopathogens and their toxins are causing harm to different organs and systems in our body.

Therefore, dentists and all other medical practitioners are not only responsible for their specific field of training/interest, but they are all co-responsible for the overall health of their patients.

It is of utmost importance to not only make patients aware of the dental–general health connection, but also to sensitise all medical professionals for this link. Therefore, a holistic medical/dental approach is highly advised.



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