Oral Health and General Health – What are the Connections?

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Continuing Education Units: 1 hour


Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

This course provides a review of the evidence for the connections and possible/proven links between oral health/conditions and general health/conditions.

Conflict of Interest Disclosure Statement
• The author reports no conflicts of interest associated with this course.

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Introduction
The use of language is key to an understanding of the current state of our knowledge and thinking on the subject of oral health, especially periodontal health, and general health. While there is an increasing recognition of some relationship, the exact nature of it remains elusive. The terms link, association and relationship are often used interchangeably to provide a description that, as yet, we cannot prove to be absolute. However, there are a mounting number of indicators from research and epidemiology that periodontal disease is connected to various other general health conditions through the commonality of inflammation. It follows that whatever level of our current knowledge, helping our patients to prevent periodontal disease and providing effective treatment for diagnosed disease can do no harm either to oral or general health, and may indeed very much benefit both.

Overview of Oral Conditions that Might Impact on General Health
The possible connections between oral ill health and general health have long been present.
Indeed in the fourth century BC, Hippocrates, the Greek physician known as ‘the father of medicine’ attributed the cure of a case of arthritis to the extraction of a tooth. Arguably, this was the earliest recorded observation of a possible link between oral infection and a systemic condition. Then, as now, the difficulty arises in being able to directly link cause and effect in a biological system as complex as the human body. Similarly, however, there is a distinct human trait in making an observation of a change and wishing to attribute it to a specific reason. It provides us with the basis of scientific method and it is from this discipline that we can begin to establish a hierarchy of evidence to attempt to better answer the questions of possible causative links between periodontal disease and systemic conditions.

Early in the twentieth century William Hunter, a British doctor, developed the theory of focal infection after noting links between oral sepsis and diseases of other body organs which he attributed to the dissemination of organisms or toxic products from the mouth. Extending his theory, which had a major effect on dentistry, Hunter connected a large range of conditions with oral sepsis including gastro-intestinal problems, cirrhosis, rheumatoid arthritis and also rather more vague symptoms such as debility and cardiac irregularity. Many of these associations were based on clinical reports of improvement after removal of the septic focus, usually the teeth. The theory gained much support from leaders of the dental profession on both sides of the Atlantic. One of its attractions was that it improved the standing of dentists who could be considered to be working in concert with the medical profession to improve the health of their patients and coincided with a campaign in Britain to limit dentistry to those with qualifications.

The acceptance of the theory of focal infection resulted in wholesale removal of teeth in an attempt to treat a variety of conditions. The oral health impact of this practice was demonstrated, for example, in the data from the first Adult Dental Health Survey of the UK in 1968 which found that 71% of those aged 55 or older were edentulous, almost certainly representing the consequences of this approach in the first half of the century. A growing recognition that no controlled clinical studies supported this theory meant that it went into abeyance, especially as the studies into dental plaque improved our understanding of the pathogenesis of dental diseases. Additionally, the emphasis on disease prevention and on maintaining a functional dentition throughout life hastened the end of the era of adherence to the belief in focal infection.

Not long after the theory had been laid to rest, reports started to emerge in the late 1980s and early 1990s from well-designed scientific studies of possible linkages between periodontal disease and other diseases. Prospective cohort studies then began to report that periodontal disease was associated with an increased risk of premature death from any cause, suggesting the hypothesis that periodontitis could be a risk factor for other diseases.

There was a subsequent explosion in clinical research in this area and periodontal disease has been linked to a number of diseases and conditions that have a major impact on public health, including cardiovascular disease, adverse pregnancy outcomes, diabetes, respiratory disease, chronic kidney disease, rheumatoid arthritis, cognitive impairment, obesity, metabolic syndrome and cancer, which have been variously reviewed.

**Periodontal Disease - Inflammation is the Key**

Periodontitis is a chronic multifactorial inflammatory disease initiated by bacterial microorganisms and characterized by a severe chronic inflammation that leads to progressive destruction of the tooth supporting apparatus, tooth loss and eventually to masticatory dysfunction. Periodontitis:
- is common
- reduces chewing function
- impairs aesthetics
- causes tooth loss
- causes disability
- leads to social inequality
- reduces quality of life
- has a significant impact upon escalating public health costs

With a high prevalence worldwide, examples of recent data confirm a continuing presence. The Adult Dental Health Survey of the UK in 2009 reported that 66% of those aged 55 and above had periodontal attachment loss (PAL) over 4mm, while...
21% had PAL over 6mm which would equate to significant periodontal destruction. These levels are similar to other data gathered worldwide; for example, the 2009/2010 National Health and Nutrition Examination Survey cycle in the United States reported that 64% of those aged 65 years and older had moderate or severe periodontitis. Such prevalence figures are high in comparison with other diseases and recently there has been a reappraisal suggesting that many epidemiological studies have underestimated the prevalence of periodontitis.

What became clearer with the increasing research were the associations between periodontitis and the selected conditions did not seem spurious, but genuine, with the common factor being inflammation. Periodontitis increases systemic inflammation, by means of bacteria entering the circulation during speech, eating and tooth brushing. These microorganisms activate an acute-phase response by the liver and stimulate immune cells, such as neutrophils, to generate ‘oxidative stress’ in the circulation. It appears it is not the bacteria as such, but the inflammatory response to them that causes the problem. The reaction takes place at a slow, low-grade but relentless pace over many years, and in doing so contributes to the overall ‘inflammatory burden’ that drives many of the inflammatory diseases of aging.

Sifting the Evidence
In 2013 the European Federation of Periodontology (EFP) dedicated its ninth European Workshop to the relationship between periodontitis and systemic diseases. The American Academy of Periodontology (AAP) were joint partners making the event the first ever EFP/AAP transatlantic workshop, which attracted representatives from as far away as the Asia-Pacific rim. Eleven exhaustive, systematic reviews, involving 24 world experts as reviewers, were commissioned to look at the relationship between periodontitis and cardiovascular disease, diabetes, adverse pregnancy outcomes and ‘other’ systemic diseases. Go to [http://onlinelibrary.wiley.com/doi/10.1111/jcpe.2013.40.issue-s14/issuetoc](http://onlinelibrary.wiley.com/doi/10.1111/jcpe.2013.40.issue-s14/issuetoc) to view the consensus reports and papers which are available free. Much of the review content below comes from these documents with due acknowledgment to the EFP/AAP.

The value of such a high level review process lies in the power of its outcome. Sieving through the evidence enables an overview of the strength and hierarchy, a process entirely missing, for example, in the case of the focal infection theory as described above. In relation to this, part of the problem may be considered to have arisen through previous, premature ‘over-hyping’ of the importance and impact of periodontitis in certain quarters, based on epidemiological evidence of variable quality, linking periodontitis with almost every human condition, including, by way of example, male erectile dysfunction!

Periodontal Disease and Diabetes
Cross-sectional and prospective epidemiological studies have shown that periodontitis increases the risk of poor glycaemic control in patients with diabetes mellitus as well as diabetes complications and associated morbidity.

The evidence for an association between diabetes and periodontitis is as follows:

- **Plausibility** – type-2 diabetes is preceded by systemic inflammation, leading to reduced pancreatic β-cell function, apoptosis and insulin resistance. Increasing evidence supports elevated systemic inflammation (acute-phase and oxidative stress biomarkers), resulting from the entry of periodontal organisms and their virulence factors into the circulation, thus providing biologically plausible mechanisms underpinning the adverse impact of periodontitis upon diabetes and its complications.

- **Epidemiological data** – consistent and robust evidence is available which demonstrates that severe periodontitis adversely affects glycaemic control in diabetes and glycaemia in non-diabetes patients. In addition, in patients with diabetes, there is a direct and dose-dependent relationship between periodontitis severity and diabetes complications. Emerging evidence indicates an increased risk for diabetes onset in patients with severe periodontitis.

- **Intervention studies** – some randomized clinical trials demonstrate that mechanical periodontal therapy associates with a moderate reduction in HbA1C at three months. A more recent, large scale multi-centre randomized clinical trial, however, concluded that non-
surgical periodontal treatment of participants with type 2 diabetes and chronic periodontitis did not demonstrate a benefit for measures of glycemic control.17

Periodontitis and Cardiovascular Disease
The evidence for an association between cardiovascular diseases and periodontitis is as follows:
   • **Plausibility** – periodontitis leads to entry of bacteria into the bloodstream. The bacteria activate the host's inflammatory-immune response by multiple mechanisms. Several animal models have demonstrated the host's inflammatory response favors atheroma formation, maturation and exacerbation.
   • **Epidemiological data** – there is consistent epidemiological evidence that periodontitis imparts increased risk for future cardiovascular disease, independently of other confounding factors.
   • **Intervention studies** – there is moderate evidence periodontal treatment reduces systemic inflammation as evidenced by reductions in C-reactive protein (CRP) and oxidative stress, and leads to improvements of surrogate clinical and biochemical measures of vascular endothelial function.

Periodontitis and Adverse Pregnancy Outcomes
The evidence for an association between adverse pregnancy outcomes and periodontitis is as follows:
   • **Plausibility** – current evidence supports the idea that oral microorganisms and their products enter the blood circulation and travel directly to the fetal environment where they cause inflammatory and immune responses affecting the feto-placental unit. These bacteria in the circulation may also circulate to the liver, where inflammatory agents are produced, which in turn then circulate to the developing fetus.
   • **Epidemiology** – in clinical studies, low birth weight, pre-term birth and pre-eclampsia have all been associated with the presence of periodontitis in the mother, when all other risk factors have been accounted for. However, the strength of the connection found between periodontitis and these pregnancy outcomes varies between studies, and some show no association. The heterogeneity of data is likely due to differences in the study designs, study populations and different methods used for assessing and classifying periodontal disease.
   • **Intervention studies** – results from clinical trials have shown that, in general, scaling and root debridement carried out during the second trimester of pregnancy, with or without antibiotic therapy, does not significantly improve adverse pregnancy outcomes, such as preterm birth and low birth weight. However, some clinical trials did report a favorable effect overall and it is possible certain populations of pregnant women may benefit from periodontal therapy, even though others will not. One reason for negative study results may be the interaction between periodontitis and pregnancy outcomes is more complex than our current understanding and the study results may have been affected by the type and timing of treatment employed and by the types of patients selected.

Periodontitis and Other Diseases
There is emerging evidence for associations between periodontal diseases and chronic obstructive airways disease, chronic kidney disease, rheumatoid arthritis, cognitive impairment, obesity, metabolic syndrome and some cancers. To date, the only evidence for causality is in relation to respiratory microorganisms that colonize the oral/periodontal biofilm and may subsequently cause a hospital-acquired pneumonia (nosocomial pneumonia) in ventilated patients.
   • **Plausibility** – respiratory pathogens arising from oral/periodontal biofilm reservoirs may be aspirated in certain risk patients within hospital environments and result in a nosocomial pneumonia.
   • **Epidemiological data** – available data supports a role for the oral/periodontal biofilm acting as a reservoir for respiratory pathogens in patients with poor oral hygiene and periodontitis, which may cause nosocomial pneumonia.
   • **Intervention studies** – randomized controlled trials strongly support a role for improving oral hygiene in the prevention of nosocomial pneumonias in acute care hospital environments and nursing homes.

Caries and Other Oral Diseases
The research focus on the role of periodontal and
systemic diseases has somewhat overshadowed consideration of other oral conditions and their possible effects on wellbeing. Caries is also a disease caused through the intervention of microorganisms and can also lead to inflammation in the form of apical periodontitis. However, the resulting impact on general health tends to be acute with better defined treatment protocols. Having said that, serious conditions such as Ludwig’s angina and septicaemias do follow in some instances. Oral cancers and pre-cancers also have a direct bearing on general health and need to be factored in to the care and treatment of dental patients.

**Suggestions of Preventive Actions and Advice to Patients**
Prevention, early diagnosis and effective treatment of periodontal disease are required in order to combat the devastating oral and general health effects for the individual and society. Periodontitis remains the most common chronic inflammatory disease of humankind – and periodontal health as a key element of oral health and general health and wellbeing. The intention is to greatly increase awareness among members of the public, the media, government, regulatory and professional bodies, and other groups as appropriate of the importance of periodontal health and, in turn, the importance of oral health to general health and wellbeing throughout life, but, in particular, in old age.

**Conclusions**
The substantial increase in our knowledge in recent years as to the possible links between periodontal disease and a range of conditions affecting general health has lead researchers to postulate that the main common factor is inflammation. While much further research and understanding are needed, the main message for oral health care professionals is to promote prevention in their patients and to undertake effective treatment of periodontal disease to reduce or eliminate its deleterious effects.
1. The theory linking oral conditions and general body health first formulated in the early 20th century but now discredited was known as:
   a. Toxic theory evolution
   b. Focal infection
   c. Oral sepsis body management
   d. Septic focus

2. During which period did evidence from scientific studies begin to emerge suggesting links between, particularly, periodontal disease and general health conditions?
   a. Prior to 1890s
   b. Mid 1950s
   c. Early 1970s
   d. Late 1980s and early 1990s

3. Which of the following is NOT a feature of periodontal disease?
   a. Causes tooth loss
   b. Is comparative rare in western populations
   c. Reduces chewing function
   d. Leads to social inequality

4. What percentage of the population aged 65 years and older had moderate or severe periodontitis according to the 2009/2010 National Health and Nutrition Examination Survey cycle in the United States?
   a. 64%
   b. 27%
   c. 55%
   d. The percentage was so low it was not recorded

5. The associations between periodontitis and various general health conditions seem to have a common factor of which of the following?
   a. Social status
   b. Inflammation
   c. Health care provider
   d. Blood pressure

6. Studies have shown that in patients with diabetes mellitus, periodontitis:
   a. Reduces the systemic burden of inflammation
   b. Increase pancreatic β-cell function and insulin resistance
   c. Increases the risk of poor glycaemic control
   d. Shows no direct or dose-dependent relationship between periodontitis severity and diabetes complications
7. The evidence from intervention studies that periodontal treatment reduces systemic inflammation as evidenced by oxidative stress, leading to improvements of measures of vascular endothelial function is:
   a. Categorical
   b. Strong
   c. Non-existent
   d. Moderate

8. In clinical studies, which of the following have all been associated with the presence of periodontitis in the mother, when all other risk factors have been accounted for?
   a. Low birth weight
   b. Pre-term birth
   c. Pre-eclampsia
   d. All of the above.

9. For which of the following diseases/conditions have periodontal diseases NOT been associated to date?
   a. Chronic obstructive airways disease
   b. Chronic kidney disease
   c. Post-traumatic stress disorder
   d. Rheumatoid arthritis

10. The condition Ludwig's angina most usually follows from:
    a. Deep scaling in periodontal treatment
    b. Periapical infection as a result of dental caries
    c. Uncontrolled diabetes
    d. Low blood pressure

11. Periodontitis is:
    a. Is the least common chronic inflammatory disease of humankind
    b. A largely irrelevant element of oral health and general health and wellbeing
    c. Likely to be eradicated by chemical agents in the near future
    d. None of the above.

12. While further research is needed into links between periodontal disease, inflammation and general health conditions, the main message for oral health care professionals should be:
    a. Not to worry about plaque control as the links are unproven
    b. To promote prevention in their patients and undertake effective treatment of periodontal disease
    c. To advise long-term bed rest
    d. To advocate lower levels of oral hygiene in sufferers of diabetes
References

About the Author

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Stephen Hancocks has been the Editor-in-Chief of the British Dental Journal and its related titles since 2004 and was the Editor of the FDI's International Dental Journal 2000-2014. Stephen left clinical practice in favor of writing, editing and publishing and has been recognized for his contributions by Her Majesty Queen Elizabeth II with the award of the OBE for services to the dental profession, Honorary Membership of the ADA and appointment to the FDI's List of Honour. As well as running his own publishing company, Stephen also owns a theater company and is an established playwright.

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