

Episode #29 – Dementia and Oral Health January 29, 2021

Dementia

As defined by the World Health Organization,

> Dementia is a syndrome, usually of a chronic or progressive nature, in which there is deterioration in cognitive function (i.e., the ability to process thought) beyond what might be expected from normal ageing. It affects memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement. Consciousness is not affected. The impairment in cognitive function is commonly accompanied, and occasionally preceded, by deterioration in emotional control, social behaviour, or motivation. [1]

Global prevalence of dementia

- Worldwide, approximately 50 million people have dementia, with nearly 10 million new cases every year.
- The estimated proportion of the general population aged 60 years and over with dementia is between 5-8%. Although dementia mostly affects older adults, it is not a part of normal ageing. Many people over 100 years do not have dementia.
- Dementia does not exclusively affect older people, young-onset dementia, defined as the onset of symptoms before the age of 65 years, accounts for up to 9% of cases.
- The total number of people with dementia is projected to reach 82 million in 2030 and 152 million in 2050. Much of this increase is attributable to the rising numbers of people with dementia living in low- and middle-income countries. [1] [2]

Prevalence of dementia in Canada

- In 2016–2017, more than 432,000 individuals aged 65 years and older were living with diagnosed dementia, of these individuals, 2/3 were women.
- Approximately 9 Canadians are diagnosed with dementia every hour.
- Between the ages of 65 and 84 years, the risk of being diagnosed with dementia doubles with every 5-year increase in age. [3]

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Health impacts of dementia
Dementia can lead to major health impacts. For example:

- 48.4% of Canadians living in the community with dementia reported having fair or poor general health and 58.4% reported limitations in their mobility (i.e., independent physical movement). [4]
- 31% of Canadians with dementia living in long-term care had signs of depression. [5]
- Overall, the risk of dying from any cause in 2016–2017 was 4.4 times higher among Canadians aged 65 years and older with diagnosed dementia compared to those without dementia. [3]

Common signs and symptoms of dementia
Dementia symptoms may vary depending on the cause and can vary widely from person to person.

Cognitive changes may include difficulty with:

- Memory, which is usually noticed by a spouse or someone else
- Communication
- Attention
- Reasoning, judgment, and problem solving
- Difficulty with visual and spatial abilities, such as getting lost while driving
- Handling complex tasks
- Planning and organizing
- Coordination and motor functions

Psychological changes may include:

- Personality changes
- Depression
- Anxiety
- Inappropriate behaviour
- Paranoia
- Agitation
- Hallucinations [6] [7]

Differences between mild forgetfulness and serious memory problems [6] [8]

Typical age-related memory changes	Possible signs of dementia
Make a bad decision once in a while	Making poor judgments and decisions a lot of the time
Miss a monthly appointment	Problems taking care of monthly bills
Forget which day it is and remember later	Losing track of the date or time of year
Sometimes forget which word to use	Trouble having a conversation
Lose things from time to time	Misplacing things often and being unable to find them
Forgetting the name of an acquaintance	Forgetting the name of a close family member or friend
Forgetting the most recent events	Forgetting old memories
Although some forgetfulness comes with age, consult a medical provider if changes in memory or thinking become a concern.	

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Benefits of early screening

If screening is negative, concerns may be alleviated, at least at that point in time.
If screening is positive and further evaluation is warranted, the medical provider can take the next step to identify the cause of impairment, such as medication side effects, metabolic and/or endocrine imbalance, delirium, depression, or Alzheimer's disease. This may result in:

- Treating the underlying disease or health condition
- Managing comorbid conditions more effectively
- Averting or addressing potential safety issues
- Allowing the individual to create or update advance directives and plan long-term care
- Ensuring the person has a caregiver or someone to help with medical, legal, and financial concerns
- Ensuring the caregiver receives appropriate information and referrals
- Encouraging participation in clinical research [9]

Dementia verses delirium

Dementia should not be confused with delirium, although cognition is disordered in both. Dementia affects mainly memory, is typically caused by anatomic changes in the brain, has slower onset, and is generally irreversible. Delirium affects mainly attention, is typically caused by acute illness or drug toxicity (sometimes life threatening), and is often reversible.

Differences between dementia and delirium* [10]

Feature	Dementia	Delirium
Onset	Slow and gradual, with an uncertain beginning point	Sudden, with a definite beginning point
Duration	Usually permanent	Days to weeks, although it may be longer
Cause	Usually a chronic brain disorder (e.g., Alzheimer's disease, Lewy body dementia, vascular dementia)	Almost always another condition (e.g., infection, dehydration, use or withdrawal of certain drugs)
Course	Slowly progressive	Usually reversible
Effect at night	Often worse	Almost always worse
Attention	Unimpaired until dementia has become severe	Greatly impaired
Level of consciousness	Unimpaired until dementia has become severe	Variably impaired
Orientation to time & place	Impaired	Varies
Use of language	Sometimes difficulty finding the right word	Slow, often incoherent, and inappropriate
Memory	Lost, especially for recent events	Varies
Need for medical attention	Required but less urgently	Immediate
Effect of treatment	May slow progression but cannot reverse or cure the disorder	Usually reverses symptoms

*Differences are generally true and helpful diagnostically, but exceptions are not rare. For example, traumatic brain injury occurs suddenly but may result in severe, permanent dementia; hypothyroidism may produce the slowly progressive picture of dementia but be completely reversible with treatment.

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Classification of dementias
Dementias can be classified in several ways:

- Alzheimer or non-Alzheimer type
- Cortical or subcortical
- Irreversible or potentially reversible
- Common or rare [11]

Common types of dementia
Alzheimer's disease dementia – The most common cause of dementia, accounting for 60-80% of cases. Alzheimer's disease causes progressive cognitive deterioration and is characterized by beta-amyloid deposits and neurofibrillary tangles in the cerebral cortex and subcortical gray matter. Diagnosis is clinical; laboratory and imaging tests are usually done to look for specific findings that suggest Alzheimer's disease and to identify other treatable causes of dementia. Treatment is supportive. Cholinesterase inhibitors can sometimes temporarily improve cognitive function.

The trademark symptom of Alzheimer's disease is trouble remembering recent events, such as a conversation that occurred minutes or hours ago. Difficulty remembering more distant memories occurs later in the disease. Other concerns such as difficulty with walking or talking or personality changes also have later onset. The disease is twice as common among women as among men, partly because women have a longer life expectancy. Family history is the most important risk factor. Having a first-degree relative with Alzheimer's disease increases the risk of developing it by 10-30%. Once someone reaches the age of 65, the risk of developing Alzheimer's doubles every five years. Although far less common, younger-onset Alzheimer's (also known as early-onset Alzheimer's) affects people younger than 65. It is estimated that up to 5% of people with Alzheimer's have younger-onset disease. Younger-onset Alzheimer's is often misdiagnosed.

Vascular dementia – The second most common type of dementia is more prevalent among men and usually begins after age 70. Vascular dementia occurs more frequently in individuals who have vascular risk factors (e.g., hypertension, diabetes mellitus, hyperlipidemia, smoking) and in those who have had several cerebrovascular accidents (CVAs), with about 10% linked to CVAs or other issues with blood flow to the brain. Many people have both vascular dementia and Alzheimer's disease. Symptoms vary depending on the area and size of the brain impacted. The disease progresses in a step-wise fashion, meaning symptoms will suddenly get worse as the individual experiences more CVAs or transient ischemic attacks (mini-strokes). The most common symptoms of vascular dementia include difficulties with problem-solving, slowed thinking, focus, and organization, personality and mood changes, and language deficits. These symptoms tend to be more noticeable than memory loss.

Lewy body dementia – The third most common type of dementia and is also known as dementia with Lewy bodies. Age of onset is typically greater than 60 years. Lewy bodies are abnormal balloon-like clumps of protein that have been found in the brains of people with Lewy body dementia, Alzheimer's disease, and Parkinson's disease. Because Lewy bodies occur in Lewy body dementia and in Parkinson disease dementia, some

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experts think that the two disorders may be part of a more generalized synucleinopathy[1] affecting the central and peripheral nervous systems. In addition to more typical symptoms like memory loss, people with this form of dementia may have problems with focus and attention. Many people also experience changes in alertness including daytime sleepiness, confusion, or staring spells. They may also have trouble sleeping at night or may experience visual hallucinations, e.g., seeing people, objects, or shapes that are not there. Auditory, olfactory, or tactile hallucinations are possible. Other signs include uncoordinated or slow movement, tremors, and rigidity (parkinsonism).

Frontotemporal dementia – This type of dementia accounts for up to 10% of dementias. Age at onset is typically younger (age 55 to 65 years) than in Alzheimer's disease, affecting men and women about equally. Pick disease is a term used to describe pathologic changes in frontotemporal dementia, including severe atrophy, neuronal loss, gliosis[2], and presence of abnormal neurons (Pick cells) containing inclusions (Pick bodies). Frontotemporal dementia most often leads to changes in personality and behaviour because of the part of the brain it affects. Individuals with this condition may embarrass themselves or behave inappropriately. For instance, a previously cautious person may make offensive comments and neglect responsibilities at home or at work. There may also be problems with language skills, such as speaking or understanding.

Mixed dementia – Occurs when more than one type of dementia is present in the brain at the same time, especially in people aged 80 and older. For example, a person may have Alzheimer's disease and vascular dementia. It is not always obvious that a person has mixed dementia since the symptoms of one type of dementia may be more prominent or may overlap with symptoms of another type. Disease progression may be faster than with one kind of dementia.

HIV-associated dementia – This type of dementia is caused by neuronal damage by the HIV virus where subcortical pathologic changes result when infected macrophages or microglial cells infiltrate into the deep gray matter (i.e., basal ganglia, thalamus) and white matter. Prevalence of dementia in late-stage HIV infection ranges from 7–27%, but 30–40% may have milder forms. Incidence is inversely proportional to CD4 count[3]. Early symptoms include slowed thinking and expression, difficulty concentrating, and apathy. Motor movements are slowed; ataxia[4] and weakness may be evident. In individuals with HIV infection, dementia may also result from other disorders, some of which may be treatable. These disorders include other infections, such as secondary

[1] Synucleinopathies are a group of neurodegenerative disorders in which the protein alpha-synuclein (a brain protein) accumulates abnormally to form inclusions in the cell bodies or axons of neurons.
[2] Gliosis refers to proliferation of glial cells, either by hypertrophy (increased cell size) or hyperplasia (increased cellular division), in response to a central nervous system insult. Glial cells or neuroglia are non-neuronal cells in the central and peripheral nervous system that do not produce electrical impulses. Glial cells maintain homeostasis, form myelin, and provide support and protection for neurons.
[3] CD4 count or CD4 T lymphocyte count measures the number of CD4 T lymphocytes (CD4 cells) in a sample of blood. In people with HIV, the CD4 count is the most important laboratory indicator of immune function and the strongest predictor of HIV progression.
[4] Ataxia – abnormal, uncoordinated movements

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infection with JC virus[5] causing progressive multifocal leukoencephalopathy and central nervous system lymphoma. Other opportunistic infections (e.g., cryptococcal meningitis, other fungal meningitis, some bacterial infections, tuberculosis meningitis, viral infections, toxoplasmosis) may also contribute.

Reversible causes – Individuals who have dementia may have a reversible underlying cause such a side effect of medication, increased pressure in the brain, vitamin deficiency (e.g., thiamin, niacin, vitamin B12), thyroid hormone imbalance, or infections (such as Lyme disease, viral encephalitis, and the fungal infection cryptococcosis). Medical providers should screen for reversible causes in patients with dementia. [2] [6] [7] [12] [13] [14] [15] [16] [17] [18]

Rare forms of dementia may be linked to infectious diseases such as Creutzfeldt-Jakob disease. [19]

Risk factors

- Age – The strongest known risk factor for dementia is increasing age, with most cases affecting those of 65 years and older.
- Family history – Those who have a first-degree relative (i.e., parent or sibling) with dementia are more likely to develop dementia themselves.
- Cardiovascular Disease **–** Research suggests that brain health is closely related to heart and blood vessel health. Therefore, factors that cause cardiovascular disease may be linked to a higher risk of developing dementia, including smoking, obesity, diabetes, hyperlipidemia, and hypertension.
- Traumatic brain injury – Head injuries can increase the risk of dementia, especially if they are severe, such as a blow to the head or injury of the skull that causes amnesia or loss of consciousness for more than 30 minutes. Approximately, 50% of traumatic brain injuries are caused by motor vehicle accidents. Individuals who sustain repeated brain injuries, such as athletes and those in combat, are also at a higher risk of developing dementia.
- Genetics – Researchers have identified several gene variants that increase the chance of developing Alzheimer's disease. The APOE-e4 gene is the most common risk gene associated with Alzheimer's; it is estimated to play a role in as many as one-quarter of Alzheimer's cases.
- Low educational attainment – Studies have linked fewer years of formal education with an increased risk of dementia. The reason for this association is unclear; however, some scientists believe more years of formal education may help increase connections between neurons, allowing the brain to use alternative routes of neuron-to-neuron communication when changes related to dementia occurs.
- Additional risk factors include depression, social isolation, and cognitive inactivity. [1] [6] [13]

[5] JC virus or John Cunningham virus is a ubiquitous human polyomavirus that is typically acquired during childhood and remains latent in the kidneys and possibly other sites (e.g., mononuclear cells, central nervous system).

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Dementia diagnosis
Medical providers can perform tests on attention, memory, problem solving and other cognitive abilities to see if there is cause for concern. A physical exam, blood tests, and brain scans such as CT or MRI scans can help determine an underlying cause. [6]

Treatment of dementia
Treatment of dementia depends on the underlying cause. Neurodegenerative dementias, like Alzheimer's disease, have no cure, though there are medications that can help protect the brain or manage symptoms such as anxiety or behaviour changes. Research to develop more treatment options is ongoing. [6]

Prevention of dementia
Research demonstrates that people can reduce their risk of dementia by participating in regular exercise, maintaining social contacts, not smoking, avoiding harmful use of alcohol, controlling their weight, eating a healthy diet, regularly challenging the mind (e.g., reading, doing crosswords, studying for a course), and maintaining healthy blood pressure, cholesterol, and blood sugar levels. [1] [6] [20]

Dementia and oral health
Multiple animal and human studies have demonstrated an association between periodontitis and dementia. For example, retrospective cohort study by Chen et al. (2017) demonstrated that a 10-year exposure to chronic periodontitis[6] was associated with a 1.707-fold increase in the risk of developing Alzheimer's disease compared with those without periodontitis. [21] Further, a number of studies have provided strong evidence of the presence of infectious microbes in the brain, from viruses (e.g., herpes simplex virus type 1) through bacteria (e.g., spirochetes) to fungi. [22]

Choe et al. (2019) conducted a retrospective cohort study to determine the association between chronic periodontitis and dementia, in particular Alzheimer's disease and vascular dementia. Their study population consisted of 262,349 participants grouped as healthy (no periodontitis) or diagnosed with periodontitis during 2003-2004. Starting from January 1, 2005, the participants were followed up until date of dementia diagnosis, date of death, or December 31, 2015, whichever came first. They found that individuals with chronic periodontitis had an elevated risk for overall dementia, Alzheimer's disease, and vascular dementia.

The authors proposed three main mechanisms to explain the association between chronic periodontitis and vascular or neurodegenerative disease: direct invasion of periodontopathogens, increased inflammatory markers, and induction of atherosclerotic plaques. First, periodontopathogens from chronic periodontitis may enter the systemic circulation and cross the blood-brain barrier to invade the brain. Once inside the brain, the pathogens' lipopolysaccharides may stimulate cytokine production, causing an increased inflammatory state. Furthermore, certain pathogen products may induce the formation of beta amyloid and tau protein, both of which are observed in Alzheimer's

[6] Note that the term 'chronic periodontitis' is now referred to as 'periodontitis' according to the 2017 AAP classification of periodontal disease. https://onlinelibrary.wiley.com/doi/full/10.1111/jcpe.12935

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disease. Second, chronic periodontitis may contribute to the development of dementia by inducing a systemic inflammatory state. Periodontitis leads to the release of proinflammatory cytokines such as interleukin (IL)-1, IL-6, and tumor necrosis factor-α. These inflammatory mediators can be transported through the blood-brain barrier into the brain, consequently causing inflammation within the brain tissue. With prolonged inflammation, beta amyloid products accumulate, which in turn induces even more cytokine production, therefore creating a feedback cycle of increasing inflammation and tissue destruction. Third, chronic periodontitis may lead to increased atherosclerotic plaques by causing endothelial cell damage. Increased atherosclerosis and damage of vascular tissue was previously shown to be associated with a heavier burden of neuritic plaques and neurofibrillary tangles, leading to an increased risk for dementia. [23]

The keystone pathogen in periodontitis, *Porphyromonas gingivalis* and its toxic proteases, gingipains, have been identified in the brains of patients with Alzheimer's disease. Thus, Dominy et al. (2019) hypothesized that *P. gingivalis* infection acts in Alzheimer's disease pathogenesis through the secretion of gingipains to promote neuronal damage. Gingipains are cysteine proteases (protein enzymes) that are essential for *P. gingivalis* survival and pathogenicity and play critical roles in host colonization, inactivation of host defenses, iron and nutrient acquisition, and tissue destruction. The researchers found that gingipain immunoreactivity was significantly greater in brains with Alzheimer's disease than in brains of non-Alzheimer's disease control individuals. In addition, they identified *P. gingivalis* DNA in Alzheimer's disease brains and the cerebrospinal fluid (CSF) of living subjects diagnosed with probable Alzheimer's disease, suggesting that CSF *P. gingivalis* DNA may serve as a differential diagnostic marker. They developed and tested potent, selective, brain-penetrant, small-molecule gingipain inhibitors in vivo. Their results suggest that gingipain inhibitors could be valuable for treating *P. gingivalis* brain colonization and neurodegeneration in Alzheimer's disease. [24]

Dioguardi et al. (2020) conducted a systematic review based on the PICO question "what is the etiopathogenetic role of periodontal disease and periodontal bacteria in the onset and progression of Alzheimer's disease compared to unaffected patients?" The researchers focused on articles from the last 30 years considering that the investigation of a possible association between periodontal disease and Alzheimer's disease had only been undertaken in the last 20 years. After applying the inclusion and exclusion criteria, there were 15 articles for the qualitative analysis.

After analyzing the literature, the authors proposed the hypothesis that the bacterial load and the inflammatory reaction related to periodontitis can intensify the inflammation in the central nervous system, eventually favouring the onset of neurodegenerative disease. Even if no direct evidence associated periodontitis with Alzheimer's disease, preliminary indirect evidence was provided by a few clinical and epidemiological studies. For example, a study by Stein et al. (2007) demonstrated a 6.4 times increased risk in developing Alzheimer's disease in patients with a reduced number of teeth as compared to the general population. However, the study was not able to establish if this association was completely casual or partially casual. Further, a study by Stewart et al. (2008), utilizing data from the third National Health and Nutrition Examination Survey

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(NHANES III), related the presence of high immunoglobulin G (IgG) levels against *P. gingivalis* to a greater possibility of memory and cognitive impairment. In fact, a statistically significant relationship between IgG, *P. gingivalis*, and dementia was found. From these studies, a correlation between periodontitis and neurodegenerative diseases can be deduced, but neither can definitely prove their possible association nor demonstrate a possible mechanism through which periodontitis can induce the onset or the evolution of neurodegenerative diseases. [25]

Zhang et al. (2020) combined data from a cross-sectional human study with data from an intervention in a rat model to assess the link between poor oral health and cognitive decline. The researchers assessed the oral health of 102 participants aged 52 to 101 years by measuring pocket depths and bleeding on probing of 10 indexed teeth, and the number of missing indexed teeth. The indexed teeth were defined as teeth 11, 16, 17, 26, 27, 31, 36, 37, 46, and 47 in accordance with the World Health Organization's community periodontal index. The results of the human study showed that cognitive function was inversely correlated to the number of missing index teeth and the probing depths. The rat model revealed that increased systemic proinflammatory cytokines (e.g., tumor necrosis factor-α [TNF-α], interleukin 1 [IL-1], interleukin 6 [IL-6]) as a result of periodontal disease may impair cognitive function. The authors concluded that poor oral health may be a risk factor for cognitive decline. [26]

Demmer et al. (2020) conducted a prospective study to evaluate whether periodontal disease was associated with an increased risk for dementia and mild cognitive impairment. The study's 8,275 participants were enrolled in the Atherosclerosis Risk in Communities Study, did not have dementia at the start of the study, and were followed over a 20-year period. The participants (mean age 63 years, 55% female) underwent a full-mouth periodontal exam and neurocognitive evaluation. Mild cognitive impairment and dementia were determined using neurocognitive testing, informant interviews, neurological exam and history, and brain MRI. Participants were classified into periodontal profile classes based on the extent and severity of gingival inflammation and attachment loss.

A total of 4,559 people were assessed at the end of the study. Overall, 1,569 (19%) of the participants developed dementia during the study. The study found that participants with healthy periodontal tissues and all their teeth at the start of the study, 264 out of 1,826 (14%) developed dementia by the end of the study. Participants with mild periodontal disease, 623 out of 3,470 (18%) developed dementia. Participants with severe periodontal disease, 306 out of 1,368 (22%) developed dementia. And 376 out of 1,611 (23%) developed dementia in the edentulous group.

Participants who were in the edentulous group had approximately twice the risk of developing mild cognitive impairment or dementia as compared to participants with healthy periodontal tissues and all of their teeth. Participants with intermediate or severe periodontal disease, who were partially edentulous, had a 20% greater risk of developing mild cognitive impairment or dementia compared to the healthy group. Confounding variable such as diabetes, high cholesterol, and smoking were also taken into account when determining the risks. The authors concluded that there was a

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modest association between periodontal disease and incidence mild cognitive impairment and dementia. [27]

Lee et al. (2020) conducted a retrospective, population-based cohort study to evaluate the long-term risk of dementia in individuals with periodontitis and its associated factors. Using Taiwan's National Health Insurance Database, the researchers identified 56,018 individuals aged ≥ 50 years with newly diagnosed periodontitis in 2000–2008. A cohort of 56,018 adults without periodontitis was selected for comparison, with matching by age and sex. Both cohorts were followed from 2000 to the end of 2013, and incident dementia was identified during the follow-up period.

Periodontitis was associated with an increased risk of dementia risk. Further, the association between periodontitis and dementia risk was significant in both sexes and in people more than 60 years. Among individuals with periodontitis, the use of statins, metformin, and influenza vaccination were associated with a reduced risk of dementia, while diabetes, mental disorders, and stroke were major significant risk factors.

The researchers offered two possible explanations for increased dementia risk in individuals with periodontitis. First, periodontal pathogens and the host immune response increase proinflammatory cytokines such as IL-1, IL-6, and TNF-a. The proinflammatory cytokines may compromise the blood‐brain barrier and can cause inflammatory reactions in the central nervous system. Periodontitis is a disease resulting from infection and inflammation, and the relationship between periodontitis and several systemic diseases have been previously investigated. Therefore, the possible mechanism between periodontitis and dementia could be the linkage between inflammation and proinflammatory cytokines. Second, microorganisms from the dental plaque biofilm can invade the brain and nervous system. The bacteria in the dental biofilm might enter the brain through the bloodstream or via nerves.

The researchers also offered possible explanations regarding the association between the use of statins, metformin, and influenza vaccination and a reduced risk of dementia, among individuals with periodontitis. Statins have a protective effect against stroke and therefore reduce the risk of dementia. Diabetes is considered a risk factor for dementia, while the use of metformin is effective for controlling diabetes, thus lowering dementia risk. People who receive influenza vaccination may have better knowledge, attitudes, and practices of disease prevention. However, the real anti-inflammatory mechanism between influenza vaccination and dementia needs further clinical trials and biochemical research to provide solid evidence.

The researchers concluded that periodontitis was an independent risk factor for dementia, and this association could be observed in the various subgroups. The beneficial effects of statins, metformin, and influenza vaccination on reducing dementia need further clinical studies. They did not suggest the use of metformin for reducing dementia risk. However, dental assessments and optimal control of correctable risk factors of dementia should be effectively and efficiently implemented in people with periodontitis. [28]

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Holmer et al. (2021) conducted an exploratory study to compare the subgingival microbiota of people with Alzheimer's disease, mild cognitive impairment, subjective cognitive decline, and cognitively healthy individuals. The study population was comprised of 154 participants (50–80 years old) diagnosed with Alzheimer's disease (n = 52), mild cognitive impairment (n = 51), or subjective cognitive decline (n = 51); 76 individuals served as cognitively healthy controls. All participants underwent a dental examination comprised of a comprehensive assessment of the oral soft and hard tissues including a periodontal examination. After completion of the periodontal examination, the deepest or the most representative periodontal pocket was selected in each quadrant for subgingival microbial sampling. One sample was collected per quadrant and the microbiotas were characterized by *16S rRNA* gene sequencing.

The relative abundance of the ten most common genera (e.g., *Fusobacterium, Porphyromonas, Capnocytophaga, Treponema, Prevotella, Campylobacter,* and *Streptococcus*) did not differ between the cases and control groups. However, the microbial richness and evenness were higher in cases than in controls and differed across the four groups. The variables with the greatest influence on the microbial community composition were related to periodontal disease followed by body mass index, study group affiliation, and smoking. Periodontal probing depths ≥ 6 mm was associated with several operational taxonomic units representing established periodontal pathogens, such as *P. gingivalis, Tannerella forsythia, Treponema denticola* and *P. intermedia*.

The authors concluded that in individuals with cognitive impairment or Alzheimer's disease, the subgingival microbiota exhibits shifts typical of periodontal disease. The alterations were mainly attributable to the higher prevalence of periodontal disease in the groups with different degrees of cognitive dysfunction. Future studies are necessary to determine whether oral dysbiosis, dysfunctional host response or both, contribute to Alzheimer's disease risk. [29]

Take home messages

The research emphasizes the need to prevent periodontal disease and its progression. More research is needed on oral health and dementia to potentially achieve early diagnosis of various infections, viral, fungal, and bacterial, which can predispose certain individuals to the initiation and progression of dementia decades prior to its disastrous clinical manifestations.

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