

Dental Health and Dementia: More than Forgetfulness



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Conflict of Interest Disclosure Statement

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Introduction – Dementia

Dental Health and Dementia: More than Forgetfulness seeks to improve the dental care provider's understanding of the interaction between periodontal disease, dental caries, and dementia. It will also serve as an aid in the clinical decision-making process to optimize dental health for patients with dementia and periodontal disease.

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Overview

In 2019, widely publicized findings indicated that enzymes (gingipains) secreted by a bacteria commonly thought to be one of the keystone pathogens for periodontitis, *Porphyromonas gingivalis* (*P.g.*), have been identified in the brain tissues of individuals with pathology and symptoms of Alzheimer's Disease at higher levels than in the brains of individuals without such symptoms.¹ This report has sparked interest in the potential role of periodontal diseases in development of Alzheimer's and other dementias. It is, however, important to note that these data are based upon a cross-sectional analysis of tissues and that gingipains were found in 96% of all tissues assessed. This report also builds upon prior animal studies that have indicated that chronic oral application of *P.g.* or the gingipains it produces increase the production of amyloid beta, a component of the amyloid plaques whose accumulation contributes to Alzheimer's Disease.² While prospective trials are necessary to identify causation and/or common disease

pathways, recent reports have speculated that periodontal health may be critical in this population.

Previous research has indicated that patients with periodontal disease are up to 70% more likely to present with Alzheimer's Disease than those who are periodontally healthy.^{3,4} This association may be due to poorer oral hygiene over time due to deficits associated with dementia, dementia patients' resistance to caregiver delivery of oral care resulting in a reduction of oral hygiene delivery, medication induced xerostomia, or other challenges associated with oral hygiene delivery for patients with dementia leading to larger dental plaque masses and/or more pathologic intraoral bacteria. It has also been hypothesized that this interaction may be mediated by inflammation, the periodontal microbiome, and the immune reactions to those pathogens.^{5,6} The elderly population (over 65 years old) in the United States is expected to nearly double from 43.1 million in 2014 to 83.7 million by the year 2050.⁷ Currently, over 5 million adults, approximately 13.9% of older adults, in the United States suffer with dementia.⁸ Additionally, the rate of total edentulism is dropping and is expected to reach as low as 2.6% by 2050, which, accounting for estimations of population growth and aging, represents a 30% decrease in overall edentulism.⁹ Furthermore, medications for dementia often increase symptoms of xerostomia and higher caries rates are seen in patients with dementia, in particular those with moderate to severe disease and/or those that reside in residential nursing care facilities.^{10,11} It follows, therefore, that a large number of older adults are dentate and suffering with dementia and will require dental care that is delivered or facilitated by primary care providers. There is a need for protocols that allow for effective oral home care for dementia patients while minimizing care resistant behaviors as well as nonsurgical interventions for patients with caries and/or periodontal diseases.¹²⁻¹⁴ This course seeks to improve the dental care provider's understanding of the interaction between periodontal disease, dental caries, and dementia. It will also serve as an aid in the clinical decision-making process to optimize dental health for patients with dementia and periodontal disease.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Understand the current scientific literature about the prevalence, etiology, and stages of dementia.
- Recognize and discuss with patients the association of periodontal diseases and oral bacteria with dementia and Alzheimer's Disease.
- Develop and implement strategies for communication and delivery of oral hygiene and dental care to patients suffering with dementia.
- Evaluate patients' risk factors and oral hygiene to develop effective intervention and treatment modalities to reduce caries and periodontal disease rates.
- Understand the utility of nonsurgical caries treatment (e.g., topical fluoride, silver diamine fluoride, etc.) in patients with moderate to advanced dementia.
- Deliver instructions to primary care providers for patients with moderate to advanced dementia to increase compliance with oral home care and decrease care resistant behaviors.

Introduction

Impaired cognitive function has been associated with worsening oral health parameters, including caries rates and periodontal clinical parameters, in cross-sectional studies.¹⁵⁻¹⁷ Epidemiologic studies have also shown that individuals with increased systemic inflammation, including elevated proinflammatory markers and cardiovascular diseases, have a higher risk of developing dementia and more rapid progression of dementia symptoms over time.¹⁸⁻²⁰ Periodontal diseases are initiated by bacterial biofilm, which induces an inflammatory response causing an increase in both local and systemic pro-inflammatory markers and resulting in periodontal pocket formation, alveolar bone resorption, and, ultimately, tooth loss.^{21,22} Both the elevated inflammatory state and oral bacteria and their byproducts associated with periodontitis have been linked to dementia.^{1,2,23-25} Additionally, patients with dementia and their caregivers must manage delivery of preventative oral hygiene measures, which can be increasingly difficult as dementia severity

increases.^{26,27} Due to the number of individuals affected by both periodontal disease²⁸ and dementia⁸ and the progressive nature of both diseases, the understanding of the interaction between periodontal disease and dementia and treatment strategies for promotion of optimal oral health in patients suffering with dementia is of utmost importance to the dental practitioner.

Epidemiology and Classification of Dementia

Dementia is not a natural consequence of aging or even extreme forgetfulness. It is a generally progressive chronic syndrome in which patients experience a deterioration in memory, thinking, behavior, and the ability to perform everyday activities.²⁹ Dementia is described in the International Classification of Disease version 10 (ICD-10) as:

A syndrome due to disease of the brain, usually of a chronic or progressive nature, in which there is a disturbance of multiple higher cortical functions, including memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement. Consciousness is not clouded. The impairments of cognitive function are commonly accompanied, and occasionally preceded, by deterioration in emotional control, social, behavior, or motivation. This syndrome occurs in Alzheimer's disease, in cerebrovascular disease, and in other conditions primarily or secondarily affecting the brain.³⁰

Nearly 10 million individuals are diagnosed with new cases of dementia each year and that number is expected to increase with increasing life expectancy worldwide.²⁹ The economic costs in the United States associated with dementia were approximated to be \$818 billion in 2015.²⁹

Prevalence and Distribution of Patients with Dementia

Dementia rates are growing at alarming proportion in all regions of the world and are related to population aging.³¹ Neurologic conditions, including dementia, were estimated by the Global Burden of Disease 2010 Study as the third leading cause of years lived with disability at global level.³²

The prevalence of dementia increases dramatically in the older elderly population. Approximately 2-3% of those aged 70-75 years are affected with dementia, whereas 20-25% of individuals aged 85 years or more have some form of the disease.³³ Data tracking prevalence in individuals over the age of 85 is limited, and therefore, it is not currently clear if dementia prevalence keeps increasing or stabilizes in these individuals.³⁴ Particularly in very old age (90+ years), women have slightly greater probability to develop dementia than men, mainly due to an age-adjusted increased risk of Alzheimer's disease (AD) (RR = 1.3).³⁵

Common Causes of Dementia

Alzheimer's disease is the most common form of dementia, causing approximately two-thirds of all cases of dementia. Other major forms of dementia are vascular dementia (affecting up to 20% of patients with dementia), dementia with Lewy bodies (approximately 15% of all dementia cases), frontotemporal dementia (less than 5% of dementia cases).³⁶ The boundaries between different forms of dementia are indistinct and mixed forms, as well as dementia as a comorbidity with other diseases, may co-exist.²⁹ Additionally, less common forms of dementia include: Parkinson's Disease Dementia, Huntington's Disease, Creutzfeldt-Jakob Disease and Other Prion Diseases, Dementia in HIV/AIDS, Traumatic Brain Injury, and Wernicke-Korsakoff Syndrome (includes dementia from alcohol abuse).³⁷

Risk factors for dementia are multifactorial and vary throughout life. Educational attainment early in life, e.g., number of years spent in education, is protective against dementia and a higher level of education may delay the onset of dementia later in life.³⁸ Additionally, hypertension, type 2 diabetes mellitus, hyperlipidemia, cognitive activity, social activity, exercise, alcohol use, diet, and smoking have also been associated with dementia development.^{38,39} Late-onset Alzheimer's, the most common form of dementia, is thought to be a multifactorial disease wherein development of the disease likely includes a combination of genetic, lifestyle and environmental factors. Genetically, a polymorphism of the apolipoprotein E (APOE)

gene, specifically APOE ϵ 4 on chromosome 19, increases individual's risk for developing late onset Alzheimer's Disease.⁴⁰ This gene and other genes are implicated in the risk of development of Alzheimer's Disease, including increasing the production of presenilin and β -amyloid precursor protein (BAPP), have been shown to enhance deposition of β -amyloid protein in brain tissue.⁴¹ In addition to these genetic risk factors, epigenetic alterations of the genome (modification of the genome to turn genes off) may be a role for environmental and lifestyle factors to influence gene expression and ameliorate or potentiate underlying genetic risk factors.⁴² Finally, recent studies have identified breakdown of the blood-brain barrier, including increased permeability, microbleeds, impaired nutrient transport, and impaired clearing of neurotoxins, as a mechanism for introduction of neurotoxic substances, potentially including bacteria and bacterial byproducts, into the brain in neurodegenerative diseases.⁴³

Cognitive Impairment Classifications

Dementia symptoms generally vary in severity and progress over time from no impairment to very severe dementia. Both the Global Deterioration Scale/Reisberg Scale and the Functional Assessment Staging Test (FAST) assign seven stages to the progression of dementia (Table 1).⁴⁴

Epidemiology and Pathogenesis of Periodontal Disease

Periodontitis is a chronic disease of the hard and soft tissue supporting the teeth caused by bacterial plaque resulting in progressive destruction of the periodontal ligament and alveolar bone.^{45,44} The disease typically has a slow to moderate rate of disease progression, but periods of accelerated attachment loss may be associated with local and/or systemic factors.⁴⁷⁻⁴⁹ Disease severity is classified as mild (1-2mm), moderate (3-4mm), or severe (\geq 5mm) based on the amount of clinical attachment loss (CAL).^{50,51} The prevalence of periodontitis has been estimated to be up to 47% of U.S. adults over age 30, or 64.7 million individuals.⁵²⁻⁵⁴ Of those individuals, 8.7% showed mild disease, 30.0% demonstrated moderate disease, and 8.5% had severe chronic

Table 1. Dementia Stages and Associated Symptoms.⁴⁴

Diagnosis	Stage	Signs and Symptoms
No Dementia	Stage 1: No Cognitive Decline	In this stage a person functions normally and has no memory loss and is mentally healthy. People without dementia would be in stage 1.
No Dementia	Stage 2: Very Mild Cognitive Decline	This stage is used to describe normal forgetfulness associated with aging. For example, forgetting names and where familiar objects were left. Symptoms of dementia are not evident to the individual or their physician.
No Dementia	Stage 3: Mild Cognitive Decline	This stage includes increased forgetfulness, slight difficulty concentrating, and decreased work performance. People may get lost more frequently or have difficulty finding the right words. At this stage, a person's loved ones will begin to notice a cognitive decline.
Early Stage	Stage 4: Moderate Cognitive Decline	This stage includes difficulty concentrating, decreased memory of recent events, and difficulties managing finances or traveling alone to new locations. People have trouble completing complex tasks efficiently or accurately and may be in denial about their symptoms. They may also start withdrawing from family or friends because socialization becomes difficult. At this stage, a physician can detect clear cognitive problems during a patient interview and exam.
Mid-Stage	Stage 5: Moderately Severe Cognitive Decline	People in this stage have major memory deficiencies and need some assistance to complete their daily living activities (dressing, bathing, preparing meals, ect.). Memory loss is more prominent and may include major relevant aspects of current lives. For example, people may not remember their address or phone number and may not know the time of day or where they are.
Mid-Stage	Stage 6: Severe Cognitive Decline (Middle Dementia)	People in Stage 6 require extensive assistance to carry out their Activities of Daily Living (ADLs). They start to forget names of close family members and have little memory of recent events. Many people can remember only some details of earlier life. Individuals also have difficulty counting down from 10 and finishing tasks. Incontinence (loss of bladder or bowel control) is a problem in this stage. Ability to speak declines. Personality / emotional changes, such as delusions (believing something to be true that is not), compulsions (repeating a simple behavior, such as cleaning), or anxiety and agitation may occur.
Late-Stage	Stage 7: Very Severe Cognitive Decline (Severe Dementia)	People in this stage have essentially no ability to speak or communicate. They require assistance with most activities (e.g., using the toilet, eating). They often lose psychomotor skills. For example, the ability to walk.

periodontitis (Figure 1).^{53,54} Risk indicators for periodontitis include male gender, Hispanic ethnicity, cigarette smoking, uncontrolled or poorly controlled diabetes mellitus, and lower socioeconomic status.⁵⁵ Individuals in the lowest quintile of socioeconomic status have two times higher prevalence of periodontitis when compared with those at the highest levels of socioeconomic status.⁵⁵

Disease progression of periodontitis has been categorized into subpopulations demonstrating rapid progression (10-15% of disease cases), moderate progression (80% of disease cases), and mild/no progression (5-10% of disease cases).^{54,56,57} The prevalence distribution of periodontal disease severity and disease progression in treated and untreated populations⁵⁸ suggests that host factors may play the larger role in disease progression after bacterial initiation.⁵⁹⁻⁶³

Proposed Mechanisms of Interaction between Periodontal Disease and Dementia

Periodontitis has been linked to cognitive impairment and dementia after controlling for confounding factors such as age, sex, and educational attainment.^{4,15,17,64-67} Disease progression in periodontal disease is associated with dysbiosis and elevated chronic inflammation, and dementia and Alzheimer’s Disease have been linked to periodontal disease through both inflammatory and bacterial mechanisms.^{17,24,25,68-73} Periodontal disease has also been linked to increased systemic and neurological markers of Alzheimer’s disease.^{17,74,75}

Common Pathways of Immune Response and Inflammatory State

Chronic inflammation is correlated with the onset and progression of Alzheimer’s Disease,



Figure 1. Periodontal Disease Prevalence in Adults over 30 Years Old the United States.¹³²

and it has been postulated that chronic inflammation and neuronal aging induces stress and neuropathological changes.⁷⁶ In this model, chronic inflammation primes the microglia and induces a hyperreactive state, which then results in a failure to clear misfolded or damaged neuronal proteins and enhances the aggregation of neuronal proteins associated with dementia, such as A β ₁₋₄₂.^{77,78} Similarly, periodontal tissue breakdown seen in periodontitis is a result of host inflammatory response to bacterial stimuli. Periodontal tissue breakdown is mediated by pro-inflammatory cytokines and mediators such as interleukin-1 β (IL-1 β), interleukin-6 (IL-6), tumor necrosis factor- α (TNF- α), prostaglandin E₂ (PGE₂), receptor activator of nuclear factor kappa B ligand (RANKL), and matrix metalloproteinases (MMPs). These pro-inflammatory mediators interact with bacteria and the surrounding tissues. The heterogeneity among individuals in this response can influence disease susceptibility and severity.⁷⁹ Additionally, periodontal disease severity is correlated to increased levels of pro-inflammatory mediators systemically.⁸⁰⁻⁸² Because inflammation may influence the progression of disease in both periodontitis and dementia, one mechanism of interaction between periodontitis and dementia may include increased levels of inflammation and their influence on neuronal function.

Microbial Interactions between Periodontal Disease and Dementia

Oral bacteria and their byproducts have been found in brain tissue^{1,2,5,73} and increased levels of serum antibodies to periodontopathogenic bacteria have been found in patients with Alzheimer's disease and dementia.^{20,24,71} These bacteria may enter the brain through several pathways: 1) bacteremias allow for bacteria within the bloodstream and degradation of the blood-brain barrier is seen in age, chronic infection, and in the presence of inflammation, 2) direct access to the brain may be gained through perivascular spaces, and 3) via olfactory and/or trigeminal nerve pathways.⁸³ In addition to the bacteria themselves, influence on the brain by bacterial byproducts including virulence factors such as lipopolysacchride, capsular material, proteolytic enzymes, and gingipains may contribute to progression of

dementia.^{1,2,20,64,84,85} Finally, epigenetic alterations of the genome at local or distant sites may alter gene expression and influence the risk conferred by those genes. Bacteria and their byproducts have been shown to increase DNA methylation and histone acetylation, which has been indicated in the development of periodontal disease, cancers, and other diseases.^{86,87}

Oral hygiene status in elderly dentate patients has also been associated with development of dementia.⁸⁸ Alteration of the oral microbiome may be achieved through oral hygiene interventions, which then can alter serum levels of microorganisms and change a potential pathway for bacteria and their byproducts to cross the blood-brain barrier.^{1,2,89} Improved oral hygiene delivery is associated with decreases in dental diseases in these populations^{90,91} and has been suggested as an intervention to reduce the direct and indirect influences of oral bacteria and their byproducts on the brain and the potential influence of these bacteria and their byproducts on cognitive decline.⁹²

Oral Hygiene in Patients with Dementia

Oral bacterial biofilms are living entities that can transform into inhospitable environments given the right circumstances.^{84,93,94} Coaggregation of periodontal pathogens allows for innocuous local commensal bacteria to transform in the presence of more virulent pathogens.⁹⁴ This overall increase in virulence of the bacterial biofilm allows for a shift in the balance in the local and systemic environments from homeostasis to dysbiosis, which can then impair the host immune surveillance and cause dysfunction in the inflammatory repair mechanisms.⁹⁴ A recent review of the literature concludes that the oral health and hygiene of elderly individuals with dementia is inadequate and should be improved through oral health education of formal and informal caregivers.^{95,96} Given the importance to oral and overall health of maintaining optimal oral hygiene, it is critical for individuals with dementia to have effective oral hygiene measures performed by them or for them by caregivers.

Delivery of Oral Home Care by Primary Caregivers

Common oral health problems in older individuals include: caries, periodontal disease,

xerostomia, candidiasis, and mucosal lesions.^{97,98} All of these conditions show an increased prevalence associated with age, likely due to age-related aggregation of risk factors, polypharmacy, and decline in dexterity leading to decreased efficiency in plaque removal.⁹⁸⁻¹⁰² These conditions are also more prevalent in individuals with cognitive impairment or dementia.^{90,91} Older patients are also more likely to experience dysphagia, difficulty swallowing, which can make performing dental procedures in these patients more complex.^{103,104}

Individuals with dementia who reside in nursing homes often have poor oral hygiene associated with gingivitis and periodontitis.^{103,104} and oral hygiene practices are likely to be omitted or provided with chemical anti-plaque agents rather than toothbrushes. A failure to mechanically remove dental plaque on a regular basis is significantly less effective in preventing gingival inflammation and caries than mechanical plaque removal.¹⁰⁵⁻¹⁰⁷ Because more than half of individuals with dementia rely on caregivers for many activities of daily living, including oral hygiene delivery, they are dependent on the knowledge and skills of others for their preventative oral health care.¹⁰⁸

One obstacle often encountered by primary caregivers is care resistant behavior (CRB) to oral hygiene delivery in patients with dementia.¹⁰⁹ Care resistant behavior is defined as behaviors with which persons with dementia withstand or oppose the helping efforts of a caregiver and can be categorized as “uncooperative,” “disruptive,” or “agitation.”¹¹⁰⁻¹¹⁵ Eighty percent of certified nursing assistants (CNAs) report CRBs in response to the delivery of oral hygiene,¹¹⁶ which have been shown to be reduced by increasing caregivers’ awareness of best practices for oral hygiene,¹¹⁷⁻¹¹⁹ recognition of CRBs,^{109,120} and strategies to reduce threat perception in patients with dementia.^{13,117,121,122} Some especially effective strategies for threat reduction during delivery of oral hygiene measures include: smiling, bridging (e.g., having the elderly patient hold a toothbrush while the caregiver is delivering oral hygiene), and the use of polite, one-step commands.^{13,121} Inclusion of these simple steps in the oral hygiene routine of caregivers can increase cooperation for elderly patients with

dementia significantly and improve oral hygiene quality and quantity.^{13,121}

Adjunctive Therapies to Improve Oral Health in Patients with Dementia

Caries incidence increases in older adults and root caries are a particular problem due to gingival recession, xerostomia, and poor plaque removal.^{91,123} These problems are particularly pronounced in patients with dementia who are unable to care for their teeth themselves, may be taking multiple medications that cause xerostomia, and may not be able to receive treatment for caries in an outpatient dental office.^{123,124} Silver diamine fluoride (SDF) is an alkaline topical solution containing fluoride and silver that has been approved by the FDA for both caries arrest and root desensitization.^{125,126} SDF is effective in caries arrest through remineralization and inhibition of collagenases and cysteine cathepsins.¹²⁷ Yearly SDF application on exposed radicular surfaces has been shown to be effective in reducing caries progression when compared to fluoride varnish and placebo with rare complaints about the dark staining that is seen with SDF.¹²⁸ Given the low cost of SDF, the infrequency of application, the relative non-invasiveness of treatment, and the simplicity of the therapy, SDF application should be considered as a preventive measure for oral health promotion in older adults with dementia.

Many patients with dementia require care for their activities of daily living, including oral hygiene.¹⁰⁸ Coordination of care between oral healthcare providers, nursing staff, and family caregivers is critical to insure optimal oral health for those patients. Understanding the role oral bacteria and their byproducts may play in the development and progression of dementia allows for better care delivery to patients. Furthermore, utilization of mechanisms to reduce CRBs when oral hygiene is delivered, as well as coordination of preventative dental care within the residential nursing home environment, are integral components for maintenance of oral and overall health for patients.

Interdisciplinary Care for Individuals in Residential Nursing Facilities

A multi-disciplinary approach should be employed for effective oral care in patients with dementia. Dentists, dental hygienists,

dental assistants, physicians, nurses, nursing assistants, and familial and other caregivers each have a unique role in providing oral health care to these patients.

Dental healthcare providers play a central role in creating a customized, long-term dental care plan for a patient that has been newly diagnosed with dementia.¹²⁹ The dentist should attempt to make a plan that includes patient-specific information and involve the individual with dementia and their family while he or she is in the early stages of dementia.¹²⁸ This may allow for increased buy-in and autonomy in treatment decisions from the patient who may then be more open to treatment and more engaged in making decisions. The plan should concentrate on eliminating pain, managing infection, and preventing new disease.¹²⁹

Education of nurses, nursing assistants, and caretakers is critical to ensure the success of proper oral care in patients with dementia.¹³⁰ Dental prostheses are growing increasingly diverse, including natural teeth, fixed bridges, dental implants, and removable prostheses.^{8,130} Natural teeth require brushing and interdental cleaning,¹¹⁹ while dentures need to be removed to be cleaned.¹¹⁸ Dental implants also require thorough preventative care to prevent inflammation and bone loss.¹¹⁸ Many nurses, CNAs, and other caretakers lack training in the complex care required different dental prostheses.¹³⁰ In addition, CRBs exhibited by patients with dementia are a major obstacle to providing effective oral care.¹³ Offering strategies to improve oral hygiene delivery to front-line care providers is crucial as they are the primary individuals delivering oral care.¹³ Strategies offered may include MOUTH interventions (Managing Oral Hygiene Using Threat Reduction).¹³ MOUTH intervention is a nonpharmacologic, relationship-based intervention.¹³ Some tactics include forming a connection by approaching the patient at or below eye level, using a friendly and calm attitude, and using brief, one-step commands.^{13,121} Care providers may have a better chance of completing mouth-care activities if they are aware of different approaches that reduce CRBs in patients with dementia.¹³

Due to the progressive nature of dementia, verbal communication between the patient and the healthcare provider or caretaker may decrease as the disease progresses.¹²⁹ Consequently, verbal communication may no longer be the best way to recognize health problems, such as tooth pain. Healthcare professionals and caretakers should be aware of non-verbal cues of dental discomfort.¹³¹ These include avoiding meals and being disinterested in eating, chewing of the lip, tongue or hands, “pulling” at the face, not wearing dentures, and aggression (particularly during activities of daily living, including oral hygiene).¹³¹

Healthcare professionals and caretakers should also consider their patient’s progression and stage of dementia. The different stages of dementia can affect how a patient will cope with dental treatments and interventions.¹³¹ Healthcare professionals and caretakers must be aware that strategies that are effective in one patient, may not be for others.¹³¹ Furthermore, a strategy that may be effective for a patient one day, may not work the next week for that same patient.¹³¹ Healthcare professionals and caretakers should recognize that treatment plans may need to change over time as the patient’s disease state changes.¹³¹

Oral hygiene must be seen as an integral part of a patient with dementia’s overall wellness and healthcare. An interdisciplinary approach allows the benefits of effective oral health to be achieved through delivery of regular oral hygiene and regular evaluation of oral health. Benefits of an increased focus on oral health may include decreased tooth loss, improved oral cancer detection, and decreased oral pain and infections. Patients with dementia may also see improvements in nutrition, decreased agitation associated with discomfort, overall health, and appearance with improved oral health.

Summary

Both the inflammation and oral bacteria and their byproducts associated with periodontitis have been implicated as able to travel from the mouth to brain tissues and implicated in the development and disease progression of

dementia and Alzheimer's disease. Because these diseases may interact, it is critically important for older adults to proactively maintain their oral health. Oral care delivery for patients with dementia can be difficult due to lack of education about oral healthcare and inability to address care resistant behaviors in patients with dementia. Older individuals with dementia also experience higher rates

of caries, xerostomia and multimorbidity associated with their dementia symptoms and/or pharmacotherapies. Delivery of preventative and minimally invasive care for periodontitis and caries within a nursing home environment is challenging, but simple interventions and coordination between interdisciplinary healthcare providers can improve outcomes for patients.

Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-us/professional-education/ce-courses/ce566/test

- 1. A 2019 study examining brain tissue from elderly individuals found that gingipains from *P. gingivalis* were present at _____ levels in brains from individuals with Alzheimer's Disease than those who did not have Alzheimer's Disease.**
 - A. Higher
 - B. Lower
 - C. Similar
- 2. The elderly population in the United States is expected to increase _____ by the year 2050.**
 - A. 50%
 - B. 2-fold
 - C. 3-fold
 - D. 5-fold
- 3. Approximately how many people are diagnosed with dementia every year worldwide?**
 - A. 2 million
 - B. 5 million
 - C. 7 million
 - D. 10 million
- 4. What was the economic impact of dementia in the United States in 2015?**
 - A. \$818 million
 - B. \$8.1 billion
 - C. \$81 billion
 - D. \$818 billion
- 5. Dementia is the _____ leading cause of years lived with a disability.**
 - A. second
 - B. third
 - C. fifth
 - D. tenth
- 6. All of the following have been associated with the development of dementia, EXCEPT:**
 - A. Smoking
 - B. Alcohol use
 - C. Hypertension
 - D. Educational attainment
 - E. All of the above have been associated with dementia development.
- 7. Approximately _____ of U.S. adults over 30 years old suffer from periodontal disease.**
 - A. 24%
 - B. 38%
 - C. 47%
 - D. 65%

8. **Chronic inflammation influences the progression of dementia. It has been hypothesized that inflammation primes the microglia and increases the production of neuronal proteins associated with dementia.**
- A. Both statements are true.
 - B. The first statement is true, the second statement is false.
 - C. The first statement is false, the second statement is true.
 - D. Both statements are false.
9. **Pathways by which oral bacteria are thought to enter the brain include _____.**
- A. bacteremias allow for bacteria within the bloodstream and chronic infection, age, and inflammation increase the permeability of the blood-brain barrier.
 - B. Bacteria may gain direct access to the brain through perivascular spaces
 - C. Bacteria may pass into the brain through olfactory and/or trigeminal nerve pathways
 - D. All of the above.
10. **Both caries and periodontal disease increase in prevalence with age and are common in older individuals. Factors that influence this increase in disease prevalence include _____.**
- A. Polypharmacy
 - B. Decline in dexterity leading to decreased efficiency in plaque removal
 - C. Aggregation of risk factors
 - D. All of the above.
11. **Care resistant behavior is defined as _____.**
- A. persons with dementia withstand or oppose the helping efforts of caregivers
 - B. caregivers that induce agitation in persons with dementia
 - C. patients with dementia related to preference for one caregiver over another
 - D. caregivers that decrease the effectiveness of healthcare delivery
12. **What percentage of certified nursing assistants report care resistant behaviors in response to oral hygiene delivery?**
- A. 30%
 - B. 45%
 - C. 60%
 - D. 80%
13. **Which of the following are mechanisms caregivers can implement to reduce care resistant behavior?**
- A. Smiling
 - B. Bridging
 - C. Using polite, one-step commands
 - D. All of the above.
14. **All of the following are true about Silver Diamine Fluoride (SDF), EXCEPT:**
- A. SDF must be applied monthly to arrest radicular caries in adults
 - B. SDF is an alkaline topical solution containing fluoride and silver
 - C. SDF has been approved by the FDA for dentinal sensitivity and caries arrest
 - D. SDF may cause black staining on carious teeth

- 15. SDF causes caries arrest by increasing fluoride availability and remineralization. SDF also inhibits of collagenases and cysteine cathepsins.**
- A. Both statements are true.
 - B. The first statement is true, the second statement is false.
 - C. The first statement is false, the second statement is true.
 - D. Both statements are false.
- 16. Which of the following are non-verbal signs of oral discomfort that may be recognized in a non-verbal patient with dementia?**
- i. Chewing of lip or tongue**
 - ii. Pulling at face or lips**
 - iii. Refusing denture wear**
 - iv. Aggression in response to oral-related activities of daily living**
- A. i, iii
 - B. i, ii, iii
 - C. i, ii, iii, iv
 - D. iv only
- 17. Involvement of the interdisciplinary healthcare team in the evaluation and delivery of oral health can result in _____ in patients with dementia?**
- A. decreased tooth loss
 - B. decreased oral pain and infections
 - C. increased identification of oral cancer
 - D. All of the above.
- 18. In patients with dementia, improved oral health may lead to improvements in overall health as well. Which of the following is not seen with improved oral health in patients with dementia?**
- A. Improved nutritional intake
 - B. Worsening sleep patterns
 - C. Decreased agitation associated with discomfort/pain
 - D. Improved appearance

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Additional Resources

- No Additional Resources Available

About the Authors

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Dr. Geisinger is an Associate Professor at the University of Alabama at Birmingham (UAB) in the Department of Periodontology where she teaches a broad range of classes and serves as the Director of the Advanced Education in Periodontology Program. She received her Bachelor's of Science in Biology from Duke University graduating cum laude and completed her dental training at Columbia University College of Dental Medicine. She completed her Certificate in Periodontology and Master's of Clinical Science at the University of Texas Health Science Center in San Antonio. Dr. Geisinger is a Diplomate in the American Board of Periodontology. In her role at UAB, she is involved in clinical and translational research. Her research focuses on periodontal-systemic interactions, periodontal regenerative therapies, implant dentistry, and educational technology. She serves on the ADA's Council on Scientific Affairs, is the Chair of the ADA's Seal Subcommittee, is a member of the American Academy of Periodontology (AAP)'s Board of Trustees, is the Chair of the AAP's task force for Women in Periodontics, and is the Immediate Past President of the American Academy of Periodontology Foundation (AAPF). She has lectured nationally and internationally on a broad range of subjects in periodontology, dental education, and oral and overall health.

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Maggie A. Misch, BS



Maggie Misch is a fourth year dental student at the University of Alabama at Birmingham (UAB) School of Dentistry. She received her BS in Health Sciences from the University of Central Florida. Maggie Misch is a member of the American Student Dental Association, American Academy of Periodontology, International Congress of Oral Implantologists, and International Team for Implantology. She is also a member of the UAB selective periodontal interest group, where she participates in advanced didactic and clinical education including seminars and hands-on experience in periodontal topics and procedures. She has worked as a research assistant in several research projects including bone augmentation using rhBMP-2, a canine study on a new dental implant design, and the management of peri-implantitis with implantoplasty and has authored and published the findings from that work. Maggie plans on continuing her education and is applying to postgraduate periodontal programs this fall.

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