Management of Periodontal Disease in Older Adults

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The health and oral health needs of individuals change across the life course. In the oral cavity, the newborn does not have teeth present in the mouth, the first primary teeth begin to erupt between 6 and 9 months of age, and usually the last of the primary teeth exfoliates at 11 or 12 years of age. Beginning with the eruption of the permanent incisors at age 6 or 7, the teeth of the permanent dentition will need to function for 70, 80, or more years and are used multiple times each day, under the harsh conditions of the oral cavity. The maintenance of a functional dentition as a person ages is dependent on many factors, including personal oral hygiene practices and lifelong access to professional dental care. A functional and esthetic dentition, free from infection and pain, allows mastication of a healthy diet and is essential to the physical and emotional well-being of older adults.

This chapter will discuss the management of periodontal disease in the older adult from a holistic perspective. The focus will be on the concerns faced by patients and providers when caring for the oral healthcare needs of older adult patients, with the emphasis on the patient, and less so on specific techniques and procedures. The context will be management of periodontal disease in consideration of overall health, which assumes a larger role as a person ages.

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1 Introduction

Globally, the prevalence of periodontitis is high. The Global Burden of Disease study identified severe periodontitis as the sixth most prevalent disorder across the globe [1]. Further, both the number of older adults (defined as 65 years of age and older) and the percentage of the population in high income countries that are in this category have increased dramatically in the last decade and are projected to continue to increase in the next few decades [2]. Since the extent and severity of periodontitis are more severe with age, identification and management of older adults with periodontitis is recognized as a significant global public health concern, and the prevalence of oral disease has not improved in the 25-year interval from 1990 to 2015 [3].

The United Nations highlighted this global population shift in its report "World Population Aging 2019" [4]. Highlights from that report include:

1. Almost all countries are seeing an increase in the number and percent of the population who are 65 years of age and older. The current global estimate of the number of older adults is 703 million people.
2. Longevity is also increasing across the globe. A person who reaches 65 years of age can expect to live another 17 years, and that number will increase in the future. Women outlive men by almost 5 years, but that difference will shrink in the future.
3. As populations age, the demands on the public health systems will also increase.
4. Population aging should be managed on the national level by certain policies targeting older adults, including promotion of healthy living, educational programs, universal healthcare, and a gradual rise in the traditional age of retirement.

In the United States, the aging of the population is a public health concern (Fig. 1). The percent of Americans who are 65 years of age and older has increased

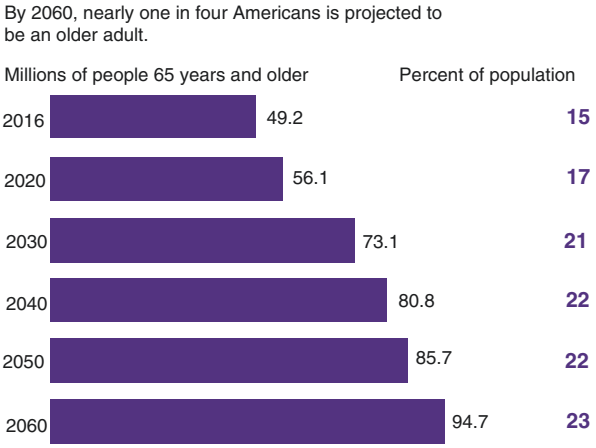

Fig. 1 Projections of the older adult population: 2020 to 2060. (Source: U.S. Census Bureau, 2017 National Population Projections; Vespa et al. [2])

dramatically. In 1960, only 9% of the population was 65 years of age and older. This percentage is projected to increase to 23% by 2060. By 2030, the percent of older adults in the population is projected to equal that of children and teenagers (21%). Further, the number of persons 85 years and older is projected to increase more than three times between 2014 and 2060, from 6 to 20 million [2]. For a more in-depth discussion on the topic, please refer to chapter "Epidemiology of Oral Health Conditions in the Older Population."

Regarding periodontitis, the prevalence in the United States is high and increases with age. The percentage of adults (30 years and older) with periodontitis has been estimated to be 42%, and almost 8% have severe periodontitis [5]. When examined by severity, the percent of individuals with any periodontitis, and the percent with moderate periodontitis, increases with increasing age, while the percentage with severe periodontitis increases until the early 50s and remains between 10 and 15% for older age groups. In addition to increasing age, other risk factors for severe periodontitis include race and ethnicity (Mexican American and non-Hispanic Black) and smoking [5].

Periodontitis is the major cause of tooth loss in older adults [6, 7] and loss of teeth can affect many aspects of a person's life. The ability to masticate normally is essential for consumption of a healthy diet. An intact and disease-free dentition allows for social interaction and avoidance of pain, resulting in better quality of life for older adults. Further, extensive oral disease, specifically periodontitis, has been associated with an increased risk of certain chronic diseases [8].

The importance of "Health in Aging" has been examined in a commentary that overviews the advances in our understanding of healthy aging [9]. Research in the past half century has led to a greater understanding of the biology of aging, how to differentiate aging from disease, as well as biological markers of the aging process. For many of the chronic health conditions that are more prevalent with aging, periodontitis has been documented as a risk factor, including cardiovascular disease [10], diabetes [11], respiratory disease [12], and Alzheimer's disease [13], or as a contributing factor in aging-associated disorders (i.e., frailty) [14]. These association studies have led to experimental studies that are identifying specific mechanisms that provide biologic plausibility for periodontitis as a risk factor for chronic diseases affecting older adults, for example, Alzheimer's disease [15]. For a more in-depth discussion on the topic of dementia, please refer to chapter "The 3 Ds: Dementia, Delirium and Depression in Oral Health."

A major emphasis is the need to reduce the period of disease so that the "health span" becomes as close as possible to the life span. This is an important concept for oral health. Further, Fried and Rowe [6] observed that health disparities will greatly influence this desired outcome. Disparities in access to oral healthcare and financial insecurity are major risk factors for oral diseases across the life course [16]. For a more in-depth discussion on the topic of health disparities, please refer to chapter "Health Disparities in Oral Health."

Periodontal disease, specifically periodontitis, is cumulative, and periodontal support for the dentition is reduced as a person ages, albeit at different rates for different individuals. Similar to many other chronic diseases that are common as a

person ages, periodontitis is a chronic disease with periods of exacerbation and remission, but with a trajectory that results in greater extent and severity of disease over time [17]. The result is loss of support for the teeth and ultimately abscess formation and discomfort, with eventual need for tooth extraction with the goal of eliminating infection. Once teeth are lost, replacement is generally required, and many options are available. However, the cost of the most satisfactory solution (dental implants and a prosthetic superstructure) is beyond the financial reach of most of the population even in high income countries and is limited to a very few individuals in low and middle income countries.

The management of periodontal disease/periodontitis in older adults involves consideration of many factors, including:

1. The status of the periodontium, and the dentition, as well as the general condition of the oral cavity including the mucosal surfaces and contiguous structures including the temporomandibular joints and muscles of mastication.
2. Health history/health status, with consideration of chronic diseases. Often consultation with other healthcare providers is necessary. Medication use, both prescription and over the counter, must be evaluated.
3. Dental history/dental status, including the frequency of visits to an oral healthcare provider, and the daily self-care (oral hygiene) regimen.
4. Social, economic, and individual considerations, including health literacy and financial security.

The goal of evaluation and planning is to create a personalized treatment approach that is both appropriate and achievable for each person.

2 Normal Oral Aging Versus True Oral Pathology

Aging is defined as the "process of growing old" but age and pathology are not synonymous. Specifically, it is important to distinguish between the concepts of "chronologic age" and "biologic age." In the former case, we are referring to the passage of time, typically in units of years, and it always increases at a set rate, i.e., an older person has more years lived than a younger person. In contrast, biologic age (also referred to as physiologic or functional age) considers factors besides date of birth such as genetics, lifestyle (exercise, weight, smoking), nutrition, and the presence of other diseases [18]. For a more in-depth discussion on the topic of age-related changes, please refer to chapter "Age-Related Changes in Oral Health."

We now understand that there are "young-old" people whose biological age belies their chronological age. This has spawned a new field of "geroscience" that seeks to understand the mechanisms that make aging a risk factor for chronic disease and that attempts to measure the rate of aging [19, 20]. Because there are often significant variations in the effects and rates of aging, chronologic age and biologic

age are often not aligned. This has significant consequences for the management of periodontal disease because treatment decisions should consider the individual variation in general health, host response, and disease expression [21].

Although with increased longevity there is an increased burden of oral disease (dental caries and periodontal disease), chronologic age alone does not have a negative influence on oral health [22]. It is therefore important to distinguish between normal effects of aging and oral disease [23]. In an older adult, normal signs of aging in the mouth would include up to 3 mm of buccal gingival recession, enamel wear and erosion, staining of any fracture lines, and darkening of teeth due to deposition of secondary dentin and enamel thinning [23]. However, in contrast to commonly held notions and beliefs, tooth loss is not a normal consequence of aging [24]. It is not age alone but the cumulative effect of other chronic systemic conditions (i.e., diabetes, osteoporosis), immunologic changes, pharmacologic interventions, functional limitations, and cognitive impairment which may have a negative effect on oral health. Personal situations, including health literacy and self-care, as well as access to professional oral healthcare, also play important roles. For a more in-depth discussion on these topics, please refer to chapters "Health Disparities in Oral Health", "The Role of Oral Health Literacy and Shared Decision Making", and "Barriers to Access Dental Care."

2.1 Salivary Function

Studies have shown that salivary function is well preserved in geriatric populations [25]. Xerostomia (dry mouth) is a condition that is often associated with old age, but it is not a consequence of aging in healthy older adults [26]. The most common cause of xerostomia in older adults are medications such as anticholinergics, tricyclic antidepressants, sedatives and tranquilizers, antihistamines, antihypertensives, and diuretics, which can dry out the oral mucosa and lead to problems with swallowing, mastication, communication, and denture retention [27, 28]. Other causes of xerostomia include several systemic conditions such as Sjogren's disease, HIV/AIDS, diabetes mellitus, and head and neck radiation therapy. A reduction in salivary production impacts the older adult with periodontitis since gingival recession accompanies loss of tooth support, exposing caries-prone root (cementum) surfaces. Overall, quality of life is greatly impacted, and individuals with dry mouth are at increased risk for dental caries, oral candidiasis, and other mucosal disorders. This becomes an even greater concern in older adults, who experience increased severity of periodontitis, accompanied by gingival recession and exposure of vulnerable root surfaces. It is therefore important for clinicians to recognize that dry mouth, although very common among older adults, is not a natural condition of aging and that the appropriate diagnosis must be ascertained to prescribe the appropriate therapy. For a more in-depth discussion on the topic of xerostomia, please refer to chapter "Xerostomia and Hyposalivation."

2.2 Periodontitis and Tooth Retention

Regarding the periodontium, recent surveillance from the National Health and Nutrition Examination Survey (NHANES) has shown that mild and moderate periodontal disease prevalence increases with age due to the cumulative nature of the disease, but interestingly, severe periodontal disease is not associated with increasing age. Periodontitis of moderate severity accounts for the majority of the age-related increase in the prevalence of periodontitis, whereas severe periodontitis prevalence is consistent at 15% or less, even among individuals 65 years and older [5]. This finding is likely attributable to the loss of the teeth at greater risk for periodontitis, and lost teeth are not generally included in periodontal indices.

Healthy aging is associated with good oral health [29]. A study of the oral health of centenarians and their offspring suggests that good oral health is a marker for systemic health and healthy aging [30]. In the Baltimore Longitudinal Study of Aging (BLSA) cohort, researchers found that there was substantial resiliency of the oral cavity during aging and that the oral cavity of healthy older people was comparable to that of healthy younger adults [31]. A study of the association between periodontal disease and mortality from all causes in the VA Dental Longitudinal Study concluded that periodontal status at baseline was a significant and independent predictor of mortality [32]. An interesting dichotomy is at play because aging alone does not contribute to oral pathology, but oral health does affects aging. It appears that it is not just that systemic disease influences oral health but that oral health influences certain chronic diseases [33, 34]. A pro-inflammatory phenotype is believed to be the mechanism underlying associations between periodontal disease and systemic diseases [35]. As noted, the severity of periodontitis is associated with an increased risk for diseases such as cardiovascular disease, diabetes, respiratory diseases, and Alzheimer's disease, as well as certain cancers, specifically lung and colorectal [36, 37].

2.3 Masticatory Function and Cognition

It is not only physical health but also mental health that plays a major role in healthy aging. Cognitive decline is a major concern among older adults, and its impact on oral health has been examined in several studies, although findings are not consistent. The interpretation of these studies is limited due to the bidirectional nature of poor oral health and impaired cognition, i.e., periodontal disease and tooth loss may be both risk factors for cognitive decline and consequences of cognitive decline. A recent systematic review assessing the relationship between oral health and cognitive function in older adults found that there was an association with specific domains of function such as learning and memory, complex attention, and executive function [38]. In the Atherosclerosis Risk in Communities (ARIC) study, a national prospective study of vascular disease among community-dwelling middle-aged

adults (45–64 years old), they assessed a 6-year change in cognitive function and multiple oral health measures and behaviors [39]. All measures of cognitive decline were associated with increased odds of tooth loss, but they cautioned that because this was a cross-sectional analysis, the association between cognitive decline and oral health could represent associations in either, or both, directions [39]. A later study of the ARIC cohort, with a final sample of 911 individuals, concluded that although complete tooth loss was significantly associated with lower cognitive performance, the number of teeth and periodontal disease did not predict subsequent cognitive decline over an 8-year period. This contrasts with other studies that have suggested that tooth loss was associated with an increased risk of both dementia and cognitive decline [40]. A mechanism to account for periodontal disease as a direct contributing factor in dementia has been described. Using both murine models and human postmortem tissue samples, the major periodontal pathogen *Porphyromonas gingivalis* and specifically proteases known a gingipains have been identified as etiologic factors in Alzheimer's disease [15].

Increasingly the importance and contribution of masticatory function to oral health and overall health has been examined (Fig. 2). Among older adults, periodontal disease is the greatest cause of masticatory dysfunction [41]. Some recent studies suggest that masticatory dysfunction due to tooth loss and/or muscle weakness may in fact be a risk factor for dementia [41, 42]. Without adequate mastication, there is a lack of stimulation of the central nervous system which leads to atrophy of the hippocampus, the area of the brain which controls learning and memory [43].

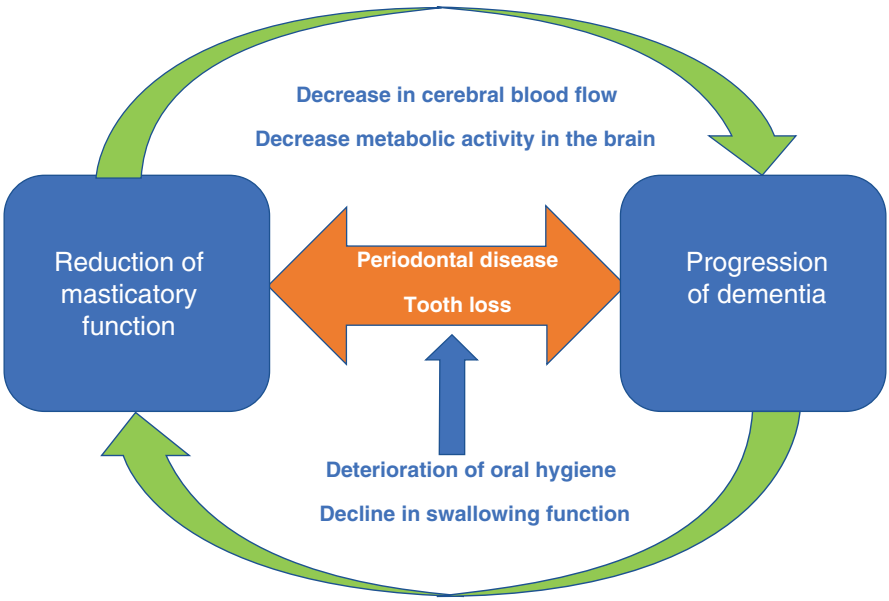

Fig. 2 Relationship between dementia and masticatory function. (Modified from Watanabe et al. (2015). Source: Watanabe et al. [41])

Animal studies support a reciprocal relationship between cognition and mastication such that a decrease in masticatory function due to tooth loss or soft diet may have negative consequences on aspects of cognitive health including spatial memory and learning ability [44]. There are some studies in humans; however, longitudinal studies are necessary to confirm a causal relationship as an explanation for the relationship between masticatory dysfunction and cognitive decline as many factors, including other comorbidities, nutrition, and reverse causation, may be at play.

3 Management of the Older Patient with Periodontal Disease

Periodontal disease is chronic, and the loss of soft and hard tissues is cumulative over the patients' lifetime [45, 46]. Older adults, thus, might present with more advanced cases of attachment and bone loss. The prevalence of periodontitis across the globe is high [1]. Severe periodontitis is most prevalent among adults 65 years or older, Mexican Americans, non-Hispanic Blacks, and smokers [5]. Dental practitioners should be aware of the high prevalence of periodontitis in US older adults and provide preventive care and counseling for this disease. In some cases, general dentists who encounter patients with periodontitis may refer these patients to see a periodontist for specialty care [5]. It is important, as for any patient and at any age, to properly diagnose and treat active periodontal disease as well as to correctly diagnose and maintain periodontal health on a reduced periodontium [47] (Fig. 3). The overarching goal should be to stabilize the periodontal condition by encouraging highly effective home self-care by the patients (or their caregivers when appropriate), eliminating areas of tissue inflammation and more involved periodontal defects, as well as ensuring frequent follow-up and professional maintenance visits. The treatment protocols for reducing inflammation and controlling periodontal disease are very similar in older adults to younger patients and should follow the same rationale [46, 47] (Fig. 4). Special attention should be paid to the manual dexterity of the patients to perform and maintain plaque control at home. Special aids should be provided and practiced individually to make sure proper home self-care is feasible and highly effective [47–50].

In recent years, there has been significant debate over the timing of recall intervals for dental appointments. Maintenance and recall visits should be individually tailored with consideration of the periodontal status, previous attachment loss, home self-care effectiveness, and adherence of the individual [50, 51]. Any deficiencies or concerns in the above parameters should prompt shorter intervals between recall and maintenance visits. The National Institute for Health and Care Excellence (NICE) in the United Kingdom issued guidelines for establishing individualized dental recall intervals [52]. For adults (18 years of age and older), the frequency was suggested to range between 3 and 24 months, dependent upon disease activity and risk factors. For older adults, however, those guidelines may not be appropriate, considering the multitude of factors that must be considered. Rather, consideration should be given to a frequency ranging from 1–2 months, when oral disease is advanced or when proper plaque control is difficult to achieve, to 6–12 months in very

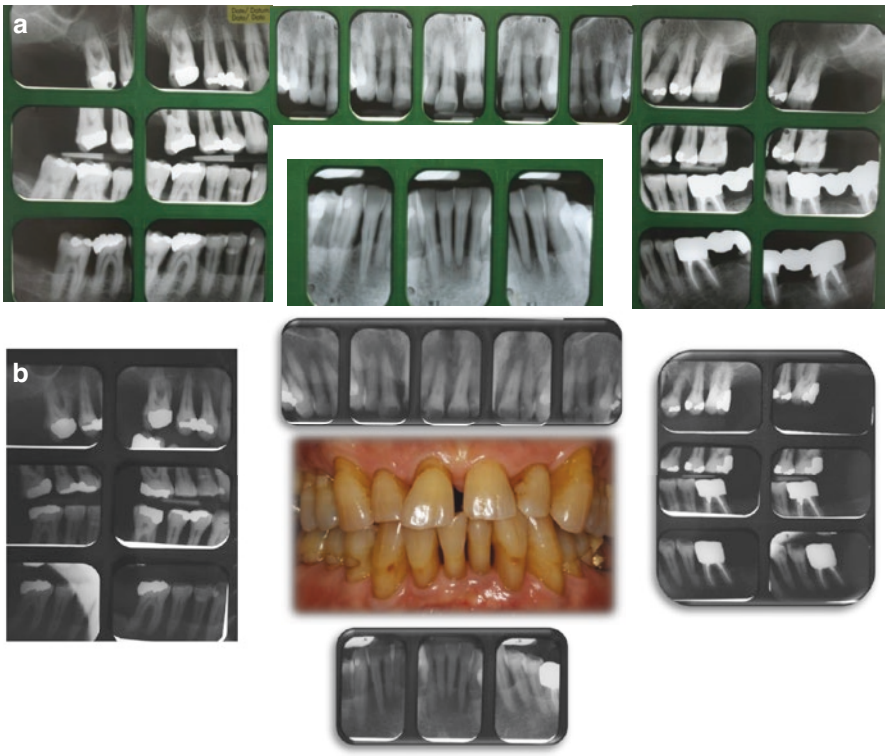

Fig. 3 A 76-year-old patient diagnosed with severe periodontal disease (**a**). Ten years following periodontal treatment (**b**), the dentition is stable, and the patient is well-maintained with no deep pockets or bleeding on probing

well-maintained and periodontally healthy individuals (Fig. 5). Factors that should be accounted for when recommending the frequency of maintenance visits include, among others, (1) oral hygiene and tobacco and alcohol consumption, (2) systemic risk and complicating factors that may influence the patient's periodontal health and their implications, (3) the outcome of previous care episodes and the suitability of previously recommended intervals, (4) the patient's ability to visit the dentist at the recommended interval, and (5) the financial costs to the patient [51]. It is important to realize that older individuals, with increasing complexity of oral and systemic conditions as well as, sometimes, decreasing ability to perform proper home self-care, will require more frequent maintenance visits.

Increasing patient knowledge of risk factors, their ability to modify risk, and providing a way for patients to quantify their risk empower patients to control their periodontal status and might help raise awareness and increase adherence. Some of the risk factors are modifiable, but others are non-modifiable, yet all need to be considered and explained to the patient. For example, plaque control by oral hygiene adherence and effectiveness is a major risk factor for periodontal disease that can be modified with proper education and training. Other risk factors are modifiable but with input from other healthcare providers. Uncontrolled or poorly controlled

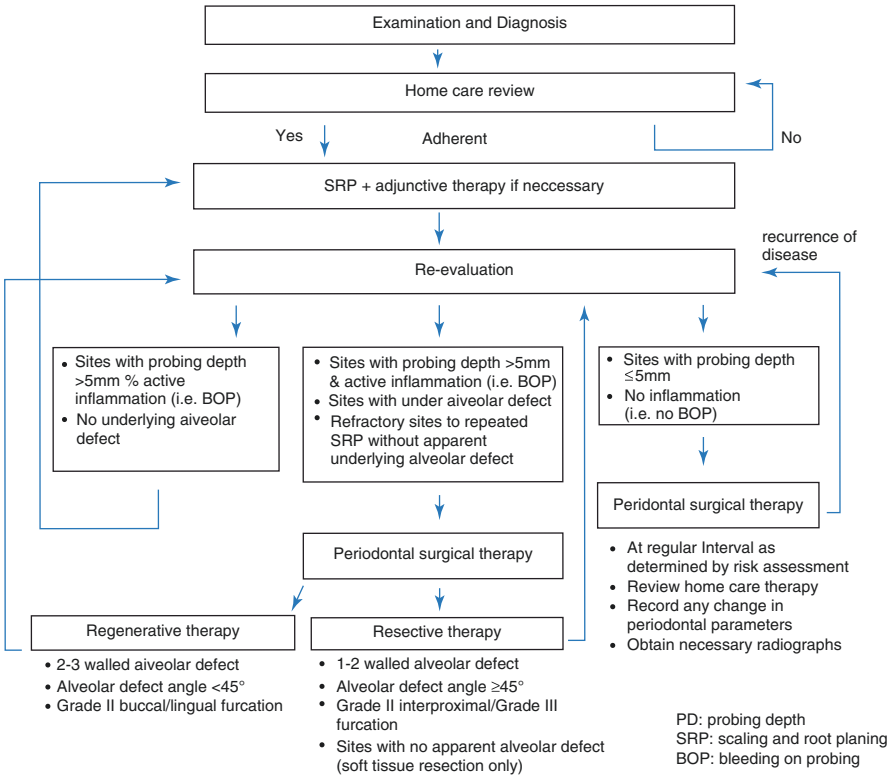

Fig. 4 A decision tree for treating a patient with periodontitis. (Reproduced with permission from Kwon et al. [46])

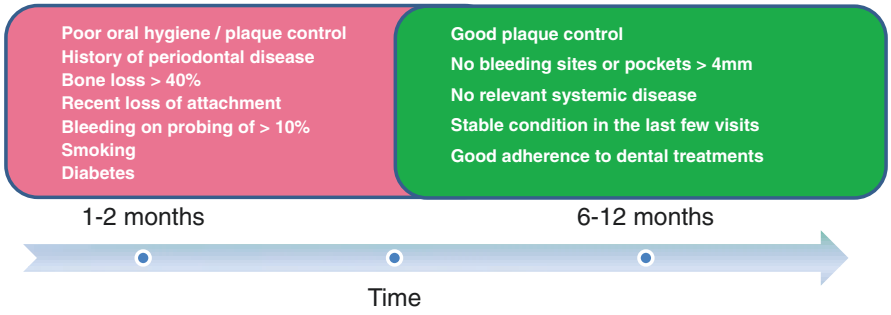

Fig. 5 Factors to be considered when determining frequency of periodontal maintenance visits. The frequency should range from 1–2 months in severe cases or in cases where proper plaque control is difficult to achieve (red box) to 6–12 months in very well-maintained and periodontally healthy individuals (green box)

diabetes is a risk factor for periodontitis, and improved glycemic control will both lessen the risk for systemic complications of diabetes and the risk of further progression of periodontitis [53]. In contrast, there is certainly a genetic component to periodontitis, which is non-modifiable [54]. Consequently, it becomes even more critical to emphasize modifiable risk factors. Goal setting has been recognized as a useful technique for improving oral health, and motivational interviewing is a broader technique that is also valuable in periodontal treatment [55].

4 Social Support and the Periodontium in Older Adults

There is ample evidence in the literature to suggest that social networks and connectedness are important determinants of good health and successful aging [56]. Social support is a modifiable risk factor for disease and thus can and should be addressed in the plan for an older individual's general as well as periodontal health. For older adults who may have limited social networks, this is an area where teledentistry may provide a crucial role and link to healthcare.

Although social support has long been recognized as an important determinant of general health (cardiovascular disease, pulmonary disease, mental health), research has increasingly recognized the impact of social support on clinical measures of oral disease, including periodontitis. Broadly defined, social support systems, also known as social networks, refer to the quality and quantity of social relationships that an individual has in their lives [57].The mechanism by which these networks affect health has been attributed to social norms, the diffusion of health-related knowledge, as well as stress resilience [58].

A few studies, including one of the English Longitudinal Study of Aging (ELSA) cohort, have found an association between structural social support and the number of remaining teeth among older adults [58, 59]. A recent study of individuals of Hispanic/Latino heritage found that US-born individuals with larger social networks had 17% lower odds of moderate-severe periodontal disease than those individuals born outside of the United States [60]. This protective effect of social capital on periodontal disease among the US Hispanic population is supported by other research and suggests that immigrant groups may be at higher risk of periodontal disease due to lack of social connectedness [61, 62].

5 Preserving Teeth or Placing Implant

In the past few decades, dental implants have assumed a fundamental role in periodontal therapy. Dental implants have consistently gained in popularity among providers and patients, sometimes at the expense of treating periodontal disease and retention of teeth. For the older adult population, it is very important to consider several important parameters before deciding to extract a tooth and replace it with a

dental implant. There are various considerations when suggesting that older adults proceed with dental implant treatment. These factors include the ability to perform and maintain proper plaque control, the actual need for the implant, some common risk factors for periodontal disease and dental implant failure, as well as the risk for peri-implant diseases. It is also of utmost importance to define and explain the planned maintenance protocol to limit future complications.

5.1 Plaque Control: Current and Future

Plaque control is the most important determinant of long-term success of dental implants [63–65]. Adequate plaque control should be achieved and maintained prior to as well as following dental implant placement. It is important to review and practice home self-care measures prior to placement of dental implants to all patients, but this is even more important when treating an older population that will present with comorbidities and reduced manual dexterity needed to maintain proper plaque control. Proper instruments should be provided and recommended to older individuals who have difficulty using traditional cleaning aids. These might include large-handle toothbrushes, special interdental cleaning aids, and electric toothbrushes. In other cases, the caregivers will play a crucial role in maintaining proper plaque control, and they should be instructed and guided on how to perform proper home self-care. It should be emphasized that the teeth being replaced were lost for a reason, and in most cases, the reason is plaque-related dental diseases. Since plaque control is a crucial component in implant success, proper home self-care practices need to be established prior to implant placement to avoid implant complications that result from the same poor self-care habits that led to the loss of teeth.

When extraction of all teeth is planned, and implant treatment will be provided in the future, the situation allows for observation of the level of self-care. The extractions can be delayed, and the existing detention can be used to educate the patient about plaque control. When there is need for total clearance, the patient probably lost their teeth due to oral disease linked to poor plaque control. If this habit is not corrected, the risk for implant complications or failure increases.

5.2 The Need for Tooth Replacement

The need to provide a dental implant in place of a missing tooth should be carefully assessed and explained to the patient. A single posterior tooth that was missing for years with no apparent consequences might be a good example of a case where an implant is not necessarily indicated. It is well established that, in some cases, bicuspid occlusion or shortened arches can provide proper support for dental and oral functions, and these options should be kept in mind when approaching

patients with missing teeth [66]. It was suggested that preserving 20 or more teeth (bicuspid occlusion) enables functions like biting, chewing, and enjoying almost all foods, regardless of the texture. This was established as a goal in some countries to encourage tooth preservation and proper dental care [67]. This concept has been shown to be well-accepted by dental providers and patients, and an analysis of nine systematic reviews concluded that this concept provided satisfactory function [68, 69]. This treatment approach was also determined to be cost-effective [70]. However, support is not universal [71], and there is a need for more long-term studies [68].

Many older patients will present with long-term partial edentulism, and their presenting condition should serve as evidence for the individual need for tooth replacement. The opposing dentition should also be examined carefully when determining the need for a dental implant. It is important to remember that a dental implant is a surgical procedure with possible short- and long-term complications [49, 63, 72], and therefore indications should be carefully weighed in consideration of possible adverse effects.

5.3 The Bone and General Healing Capacity of Older Adults

Overall, studies indicate that implants can be successfully placed in older adults. Since older adults might present with impaired healing capacity due to systemic diseases and altered metabolism, the osseointegration process as well as the soft tissue response around dental implants might be jeopardized. Further, all three stages of gingival/oral mucosal wound healing (inflammation, tissue formation, and remodeling) have been shown to be adversely affected by aging [73]. A variety of factors are involved in the long-term success of the implant, and special consideration should be taken prior to placing implants in older adults to limit the influence of those risk factors [74, 75]. Systemic conditions such as diabetes, osteoporosis, and other diseases that impair bone and soft tissue healing might delay or jeopardize implant success and survival. Specific treatments such as treatment with bisphosphonates might also lead to short- and long-term complications following surgical interventions, and thus, a thorough medical history is of utmost importance.

5.4 Other Diseases and Conditions that Might Influence Success (Diabetes, History of Periodontitis)

Common risk factors for periodontal disease and tooth loss as well as long-term implant survival were discussed previously. While aging itself is not considered a risk factor for implant loss [76], older individuals with a history of periodontal

disease are at greater risk for implant failure over time [77–79]. These factors should be all taken into consideration when developing a treatment plan.

5.5 Maintenance Protocol

As discussed above, a maintenance protocol should be tailored to each patient according to an individualized assessment of existing severity of disease, identifiable risk factors, and home self-care and personal characteristics. Patients, especially older adults with dental implants, should be seen more frequently for maintenance visits to maintain adequate health of the dentition as well as to detect and treat early complications as soon as possible [49, 77]. While it is recognized that dental implants and the natural dentition have some important differences in their biologic characteristics, this risk profile should be considered when developing the maintenance protocol for patients with dental implants [80].

5.6 Consideration of Future Implant Complications

While a clinician may observe that an implant is an excellent option when compared to a tooth demonstrating advanced periodontal involvement or extensive caries, the need to consider the possibility of future implant complications is part of the treatment planning process. Peri-implant diseases are becoming more prevalent, and management of these complications, including implant failure, should factor into the treatment approach. A history of periodontal disease is a risk factor for the development of peri-implant disease [81] and should be taken into consideration since many older adult candidates for implant placement have lost their teeth due to periodontitis.

Peri-implant diseases are inflammatory conditions affecting the soft and hard tissues around dental implants. The main clinical characteristic of *peri-implant mucositis* is bleeding on gentle probing where erythema, swelling, and/or suppuration may also be present. *Peri-implantitis* is a plaque-associated pathological condition occurring in tissues around dental implants, characterized by inflammation in the peri-implant mucosa and subsequent progressive loss of supporting bone [82]. Peri-implant complications is a rather new concern, and its prevalence is increasing in recent years [82]. Older adults might be at increased risk for peri-implant diseases [80, 83]. Prevention is the most effective way to mitigate peri-implant disorders, and this begins with proper home self-care and regular professional care. Regular care will also allow for early detection of the disease [65, 84]. Since there is currently no “gold standard” of treatment for peri-implantitis lesions, prevention and early detection are of primary importance.

6 The Dental Office as a Point of Care in the Management and Screening for Systemic Disease

The dental office offers potential as a health location to promote general health and provide screening opportunities for conditions other than oral diseases [85]. Integration of dental professionals into the larger medical care system could advance efforts to identify and control prevalent conditions such as cardiovascular disease, diabetes mellitus, and respiratory disorders, each of which is associated with significant morbidity and healthcare costs [86]. Studies have suggested that a dental office is a suitable setting for the purpose of screening and referrals for these conditions and may result in medical expenditure savings [86–88]. The identified relationship between periodontal diseases and certain chronic systemic conditions should be emphasized and taken into consideration when treating the older adult with periodontitis.

Dental professionals can identify patients who are at risk for chronic systemic diseases and may otherwise not have the opportunity for screening [89, 90]. As an example, assessment of hyperglycemia in clinical dental settings has been widely studied and been found to be effective in identifying patients with previously unidentified hyperglycemia (glycated hemoglobin in the pre-diabetes and diabetes range) [91]. Referral to a medical provider for follow-up evaluation is an essential part of this new professional responsibility.

Promoting oral health might have a significant influence on general health as well, especially regarding cardiovascular diseases and diabetes. In a recent study which assessed the impact of periodontal treatment on diabetes-related healthcare costs in patients with diabetes, it was recommended that periodontitis, a possible complication of diabetes, should receive appropriate attention in diabetes management. The fixed-effect models showed −€12.03 (95% CI − €15.77 to −€8.29) lower diabetes-related healthcare costs per quarter of a year following periodontal treatment compared with no periodontal treatment. The findings of this study provide corroborative evidence for reduced general healthcare costs associated with conservative periodontal treatment in patients [92]. The staff at the dental office can also provide advice and help with other general preventive measures such as dietary consults and lifestyle changes to promote general health. Delivering a global message of overall health promotion may also make it easier to highlight the importance of oral health maintenance [88].

7 Conclusions

In the past, there was a common belief that tooth loss was part of aging, like hair loss, facial wrinkles, and other obvious signs of aging. Furthermore, patients sometimes would easily accept treatment plans that included tooth extraction. That is now changing, as many members of the generation born after the Second World War have enjoyed regular dental care and a complete or near-complete dentition as they age. As a profession, dentists and dental hygienists must constantly emphasize the

importance of prevention of dental caries and periodontal diseases and dispel the notion that tooth loss is expected as a person ages.

This is an illogical situation. If a patient is told that a toe needed to be lost, they would demand an explanation and understand how they can prevent similar outcomes in the future. The emphasis on prevention of tooth loss did not exist in the past, but that is changing, and must be consistently reinforced. Patients lose teeth due to caries or periodontal diseases, both of which are plaque-induced and generally preventable. By truly emphasizing prevention, perhaps in the context of a general healthy lifestyle, oral healthcare professionals can change patients' perception and behavior [93]. In that sense, all dental practitioners must be aware of the unique challenges that present when caring for the oral health of older patients. This will require additional emphasis in both pre-doctoral and post-doctoral education.

One critically important consideration is the ability of older adults to afford dental care services. In the United States, dental insurance is often a benefit of employment and is lost when a person retires. The definition of "older adult" has tended to focus on 65 years of age, which is the age when US citizens often consider retirement and become eligible for Medicare insurance. Medicare provides medical benefits but very limited dental benefits and then only for "medically necessary services." Routine preventive dental care is not covered (https://www.medicare.gov/coverage/dental-services). In the United State, less than 30% of older adults have dental insurance [94]. Therefore, retention of teeth, with a focus on teeth at increased risk of being lost due to periodontitis (maxillary and mandibular molars), should begin early in life and be re-assessed as a person enters their adult years. Consequently, older adults are faced with significant out-of-pocket expenses when accessing dental services. This occurs at a time when financial resources are fixed, and the additive effects of dental disease may require more care than earlier in life.

The need for inclusion of oral health benefits for older adults in national health plans must be a part of the solution to the high prevalence of dental disease in older adults [95]. The emphasis on improving the oral health of children in the United States has not been realized by middle-aged and older adults [95, 96]. In the United States, the effort to add basic oral health benefits into the Medicare program is gaining traction [97] with the compelling arguments of improved oral health and quality of life for older adults, as well as the potential for substantial savings in healthcare expenditures [92, 98]. These benefits are primarily associated with the provision of preventive periodontal services. Oral healthcare professionals and dental professional organizations must lead the effort to enact this change.

In conclusion, research and clinical developments over the past 20 years have led to a re-evaluation of the approach to the management of the older patient with periodontitis. The identification of periodontitis as a risk factor for many chronic diseases, as well as the impact of certain chronic diseases and environmental factors (i.e., smoking) on the progression and management of periodontitis, requires a thorough understanding of these conditions, often in close consultation with other healthcare providers. Paradoxically, this situation is complicated by the success realized in reducing tooth loss, resulting in older adults with a greater number of

teeth at risk for progression of periodontitis. Further, a reduced or disease-affected detention will negatively impact the quality of life of older adults.

The concern over the available resources to pay for periodontal care further complicates clinical management. The result is the need to develop individualized treatment approaches for each patient. Therefore, these considerations require a comprehensive, multidisciplinary, and interprofessional approach that can redefine the practice of dentistry in a context of health.

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