

Oral Health in an Aging World: Systemic Burden, Functional Decline and the Prosthetic Rehabilitation Challenge: A Literature Review

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Abstract

Population aging has transformed oral health into a major public health concern worldwide. Older adults commonly experience tooth loss, periodontal disease, xerostomia, polypharmacy-induced salivary dysfunction and reduced masticatory efficiency conditions that negatively affect nutrition, cognition, communication and overall quality of life. Growing evidence supports bidirectional relationships between oral diseases and systemic disorders including cardiovascular disease, diabetes mellitus, aspiration pneumonia and cognitive decline, all of which increase the complexity of rehabilitation in aging populations. This review analyzes recent evidence on the impact of aging on oral health, examining oral-systemic interactions, polypharmacy effects, functional decline related to mastication and challenges of prosthetic rehabilitation in older adults. The literature demonstrates that masticatory efficiency extends well beyond food breakdown, functioning as a clinical indicator of broader functional vulnerability. Integrating oral health into geriatric care pathways is essential for improving health outcomes in an aging world.

Keywords: Aging; Oral Health; Geriatric Dentistry; Periodontitis; Xerostomia; Masticatory Function; Prosthetic Rehabilitation; Polypharmacy; Edentulism; Quality of Life

Introduction

Over the years, the global population has grown at an unprecedented pace. By 2020, the number of people aged 60 and older has already reached 1 billion and this figure is expected to rise to 1.4 billion by 2030 and 2.1 billion by 2050 [1]. As a result, oral disorders now account for 8.9 million disability-adjusted life-years in individuals older than 60, making oral health a key component of the global noncommunicable disease agenda [2]. Living longer, however, does not mean living healthier. Older adults increasingly face a growing burden of oral disease, including tooth loss, xerostomia and periodontal disease, often without the preventive care or treatment needed to manage these conditions [2].

Beyond its visible impact on appearance, tooth loss among adults aged 65 and older has risen steadily, affecting quality of life, nutritional intake and everyday social activities such as speaking and self-confidence [3]. Research has also linked tooth loss directly to geriatric frailty, showing that each tooth retained is associated with better physical function and lower frailty scores, positioning edentulism as a broader public health concern [4]. The prevalence of edentulism varies widely, ranging from 1.3% to 78.0% in adults over 65 years, with the highest rates found in low-income countries where access to dental care and social services remain limited [3]. What was once seen as an unavoidable part of aging is now recognized as a largely preventable

public health failure.

Equally common and often overlooked, xerostomia and hyposalivation are oral conditions frequently triggered by polypharmacy, affecting between 30 and 40% of adults over 65 years of age [5]. Saliva does much more than keep the mouth moist; it plays a key role in protecting the mucosa, fighting bacteria, supporting remineralization and making swallowing possible. When salivary flow is reduced, the mouth becomes more vulnerable to dental caries, dysphagia, malnutrition, candidiasis and prosthetic intolerance, all of which affect the overall health and quality of life of older patients [5].

At the same time, aging brings changes to the immune system that directly affect oral health. The dysfunction of neutrophils and a reduced inflammatory response make older adults more susceptible to periodontal disease, which tends to be more severe and harder to control in this age group [6]. Growing evidence also suggests that tooth loss and problems with bite function may play a role in cognitive decline, including the development of Alzheimer's disease, a relationship that operates in both directions since cognitive impairment also reduces the ability to maintain proper oral hygiene [7]. In the United States, by 2030, one in every five people, representing more than 70 million Americans, will be 65 or older and facing these chronic oral conditions, where pain is often not reported but the disease continues to progress silently [8].

Understanding these connections makes it clear that oral health can no longer be managed separately from general health. Incorporating oral health into chronic disease management strategies and increasing awareness among non-dental providers are essential steps toward improving outcomes in older adults [2]. Public health interventions must prioritize the early examination of each oral health condition, recognizing that opportunities to improve oral health are often lost when its importance is overlooked by healthcare professionals outside of dentistry [3].

Oral health is a key determinant of systemic health, with well-established connections to cardiovascular disease, diabetes and cognitive decline; these relationships are bidirectional and clinically significant for every health professional involved in the care of older adults [6]. However, many older patients still face important barriers to accessing dental care, including reduced mobility, high costs, low health literacy and healthcare systems that continue to exclude dentistry from geriatric care pathways [3]. Addressing these barriers is not optional. This review examines each of these domains in sequence, beginning with the bidirectional relationship between oral disease and systemic health and moving toward a comprehensive understanding of the rehabilitative challenges that aging patients present. Each domain is distinct, yet none can be fully understood in isolation.

Systemic Associations: The Bidirectional Relationship

Oral health is increasingly recognized as a fundamental component of systemic health, particularly within aging populations. Current evidence from major scientific organizations demonstrates that oral diseases, especially periodontitis, are not merely local conditions confined to the oral cavity; they participate in chronic inflammatory pathways that influence cardiovascular disease, diabetes mellitus, cognitive decline and aspiration pneumonia. Importantly, this relationship is bidirectional: systemic diseases can worsen oral conditions, while oral disease itself can actively contribute to the onset or progression of systemic illness [8,9]. Aging amplifies both directions of this interaction because older adults commonly experience multimorbidity, immune dysregulation, polypharmacy, frailty, salivary dysfunction and reduced ability to maintain adequate oral hygiene (Fig. 1) [10,11].

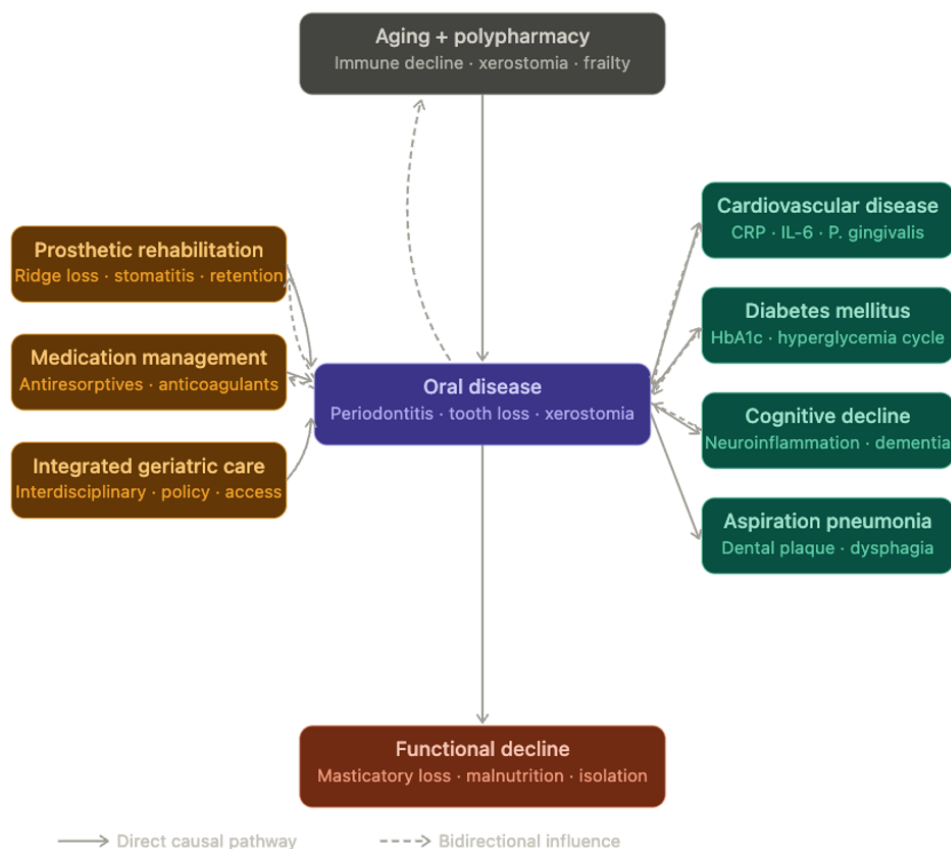


Figure 1: Bidirectional oral-systemic pathway map [10,11].

One of the most extensively studied associations is the relationship between periodontal disease and Cardiovascular Disease (CVD). Chronic periodontal inflammation contributes to systemic dissemination of inflammatory mediators such as C-reactive protein, tumor necrosis factor- α and interleukin-6, all of which are implicated in endothelial dysfunction and atherosclerotic plaque development [8-12]. Additionally, periodontal pathogens including *Porphyromonas gingivalis* have been identified within atherosclerotic plaques, suggesting a direct microbial contribution to vascular pathology [13]. Recent evidence supports a significant association between periodontitis and coronary artery disease, stroke and adverse cardiovascular outcomes [8]. Likewise, cardiovascular disease may negatively affect oral health due to impaired vascular integrity, medication-related xerostomia and physical limitations that compromise oral hygiene practices. In elderly individuals, this interaction becomes particularly significant because both advanced periodontal disease and cardiovascular comorbidities become increasingly prevalent with age [10-14].

The association between diabetes mellitus and periodontal disease is widely considered one of the clearest examples of bidirectionality in oral-systemic health. Hyperglycemia alters neutrophil function, collagen metabolism and vascular repair mechanisms, thereby increasing susceptibility to periodontal inflammation and tissue destruction [9]. Conversely, chronic periodontal infection contributes to systemic inflammatory burden, which interferes with insulin signaling and glycemic control [9,10]. Studies have demonstrated that individuals with poorly controlled diabetes exhibit greater severity of periodontal disease, while periodontal therapy has been associated with improvements in glycated Hemoglobin (HbA1c) levels [15]. In aging adults, the coexistence of diabetes, tooth loss, malnutrition and frailty creates a self-perpetuating cycle that compromises both systemic and oral health outcomes [14].

Another emerging area of interest involves the relationship between oral health and cognitive decline. Increasing evidence suggests that chronic oral inflammation may contribute to neurodegenerative processes through systemic inflammatory pathways, vascular dysfunction and microbial dissemination [10,11]. Periodontal pathogens and inflammatory mediators have been implicated in mechanisms associated with Alzheimer's disease and dementia [11]. Furthermore, tooth loss and reduced masticatory efficiency may contribute indirectly to cognitive deterioration by impairing nutrition, speech, social interaction and

quality of life. However, the relationship is also reciprocal; older adults with cognitive impairment frequently demonstrate worsening oral hygiene due to diminished self-care capacity, medication-induced xerostomia and increased dependency on caregivers [15]. As dementia progresses, oral disease severity often increases, while chronic oral inflammation may further exacerbate neuroinflammatory processes. This cyclical relationship is particularly important in geriatric populations because cognitive decline and oral dysfunction frequently coexist and mutually reinforce one another [10-14].

Poor oral health is also strongly associated with aspiration pneumonia, one of the leading causes of morbidity and mortality among frail older adults. Dental plaque and periodontal pockets serve as reservoirs for respiratory pathogens that may be aspirated into the lower respiratory tract, particularly in individuals with dysphagia, neurological disorders or reduced functional status [12]. Research demonstrates that inadequate oral hygiene significantly increases the risk of respiratory infections in hospitalized and institutionalized elderly populations [15]. Importantly, oral hygiene interventions, including professional dental cleaning and daily plaque control protocols, have been associated with reductions in pneumonia incidence and mortality [12]. Aging magnifies this relationship because older adults commonly experience impaired swallowing reflexes, sarcopenia, immune dysfunction and reduced salivary flow, all of which increase susceptibility to aspiration events. Simultaneously, systemic illness and hospitalization frequently worsen oral hygiene conditions due to dependence on caregivers and reduced access to dental services [14].

Overall, current literature strongly supports the concept that oral and systemic health are inseparably interconnected, especially in aging populations. Oral diseases contribute to chronic inflammation, vascular dysfunction, metabolic dysregulation, neurodegeneration and respiratory infection, while systemic illnesses simultaneously impair oral tissue health and oral hygiene maintenance [14,15]. This bidirectional model highlights the importance of integrating oral healthcare into broader medical and geriatric care strategies. In the context of global population aging, maintaining oral health should not be viewed solely as a dental objective; it should be understood as an essential component of healthy aging, disease prevention and preservation of functional quality of life [16].

Polypharmacy and Iatrogenic Oral Compromise

Polypharmacy represents a clinically important pathway through which the systemic management of chronic disease may unintentionally compromise oral health in older adults. Older adults commonly receive long-term pharmacologic therapy for hypertension, depression, cardiovascular disease, chronic pain, osteoporosis and thromboembolic disorders; many of these medications carry xerogenic, anticholinergic, mucosal or hemostatic effects. Recent evidence describes medication burden as a risk multiplier for oral disease in elderly patients, contributing to xerostomia, altered taste, dental caries susceptibility, periodontal complications and difficulties in maintaining oral hygiene [16]. Therefore, oral deterioration in aging patients should not be interpreted only as a consequence of biological aging; it must also be recognized as the result of medication-related changes affecting saliva, mucosal integrity, gingival tissues, bleeding risk, bone metabolism and the long-term success of restorative and prosthetic care [16,17]. Polypharmacy should not be treated as a passive medical history finding; it should be interpreted as an active oral disease modifier.

The clinical relevance of medication-induced xerostomia extends well beyond the sensation of oral dryness. Saliva supports lubrication, buffering capacity, remineralization, antimicrobial defense, swallowing, taste perception and removable prosthesis retention. When this protective system is compromised, older patients become more susceptible to dental caries, cervical and root demineralization, oral candidiasis, mucosal discomfort, dysgeusia, dysphagia and difficulty tolerating removable prostheses [18]. Clinical evidence in elderly patients confirms that medication-induced xerostomia is associated with measurable reductions in unstimulated salivary flow and is closely influenced by the patient's pharmacologic profile [17]. Longitudinal data from a 75-year-old population further support that xerostomia is a relevant geriatric oral condition, with higher reported prevalence at older ages and significant associations with general oral health and function over time [18]. In polymedicated older patients, xerostomia has also been associated with poorer oral health-related quality of life, reinforcing its clinical relevance beyond a simple symptom report [19].

Other medication classes introduce distinct patterns of oral vulnerability. Antihypertensive therapy, particularly calcium channel blockers, has been associated with gingival enlargement, which can favor plaque retention, periodontal inflammation, esthetic concerns and difficulties with oral hygiene [20]. In prosthetic or restorative patients, inflamed or enlarged gingival tissues may

compromise impression accuracy, marginal adaptation, plaque control and comfort. Anticoagulants and antiplatelet agents do not typically cause chronic tissue breakdown; however, they require careful dental planning because they influence bleeding risk during extractions, periodontal procedures, implant surgery and preprosthetic surgery [21]. Likewise, medications that affect bone metabolism, such as antiresorptive agents, may complicate implant-related planning and surgical decision-making because of their association with medication-related osteonecrosis of the jaw and implant complications [22].

The FDI criteria offer a useful common language to describe these medication-related consequences across biological, functional and esthetic domains. Within this framework, xerostomia, gingival inflammation and impaired healing may contribute to biological failures such as recurrent caries, marginal discoloration, periodontal complications, sensitivity and mucosal disease. Functional consequences may include reduced chewing comfort, impaired prosthetic retention, restoration failure and difficulty maintaining hygiene [23]. This approach allows pharmacologic risk to be connected with restorative and prosthetic outcomes in a standardized and clinically reproducible way.

Overall, polypharmacy creates a modifiable, pharmacologically driven layer of oral vulnerability that is distinct from biological aging alone. For this reason, recent literature emphasizes the importance of medication review, salivary assessment, caries risk control, fluoride strategies, periodontal monitoring and interdisciplinary communication as part of dental management for older adults exposed to multiple medications [16,17-19]. This connects directly with functional decline, because medication-induced xerostomia and oral discomfort may impair mastication, swallowing, prosthetic tolerance, oral health-related quality of life and nutritional stability in older patients [18,19].

Functional Decline-Masticatory Efficiency, Nutrition and Quality of Life

Functional decline in older adults is a multifactorial process in which oral function plays a determining, although frequently underestimated, role. Masticatory function is defined as a neuromuscular process involving the coordination of teeth, masticatory muscles and structures of the stomatognathic system to allow adequate food breakdown and facilitate swallowing and digestion [23]. The deterioration of this ability has been associated with systemic diseases; therefore, clinical evaluation of masticatory capacity in older patients can serve as a meaningful indicator of broader health decline [24].

Evidence from umbrella reviews suggests a close relationship between oral health and frailty, where physical frailty was associated with a reduced number of functional teeth, specifically fewer than 20 teeth and deterioration in oral functions including mastication [25]. This relationship underscores the degree to which oral function is embedded within the larger picture of geriatric health.

Masticatory function is central to nutritional homeostasis and with aging this function is compromised by multiple converging factors including tooth loss, xerostomia and muscle atrophy. These changes lead to nutritional imbalance; reduced intake of protein, fat, complex carbohydrates and vitamin C negatively affects systemic health over time [26]. Evidence derived from quantitative syntheses, including systematic reviews and meta-analyses, has demonstrated that deficits in masticatory function in older adults are closely related to malnutrition. Patients with masticatory difficulty tend to avoid foods of harder or mixed consistency, including meats, fruits and vegetables, which typically provide higher nutritional value. Instead, they shift toward soft-textured foods such as cereals, pasta, rice and processed items, thereby increasing nutritional risk [27,28].

Oral functional decline has been consistently associated with poorer health-related quality of life. The reduction in masticatory capacity is frequently accompanied by pain and oral discomfort, transforming mealtimes into a source of avoidance rather than enjoyment [29]. These limitations also affect psychological well-being, contributing to frustration, decreased self-esteem and social withdrawal, since shared meals carry significant cultural and interpersonal meaning. Patients with reduced masticatory function often avoid social dining encounters, a pattern that reinforces isolation and compounds their vulnerability [30].

Recent longitudinal and causal studies have further indicated that poor masticatory function may be associated with an increased risk of mortality in older adults, reinforcing its importance as a predictive indicator of general health status [30]. From a clinical standpoint, preserving and restoring masticatory function should be considered a core component of comprehensive geriatric care. Therapeutic approaches targeting oral function, including prosthetic management and structured oral function training, have demonstrated beneficial effects on physical performance and functional capacity in older adults [31].

In summary, masticatory efficiency represents a central link between oral health and systemic function in an aging world. Reduced masticatory performance should be viewed not merely as a localized dental issue, but as an early manifestation of broader functional decline with genuine systemic repercussions (Fig. 2) [29-31].

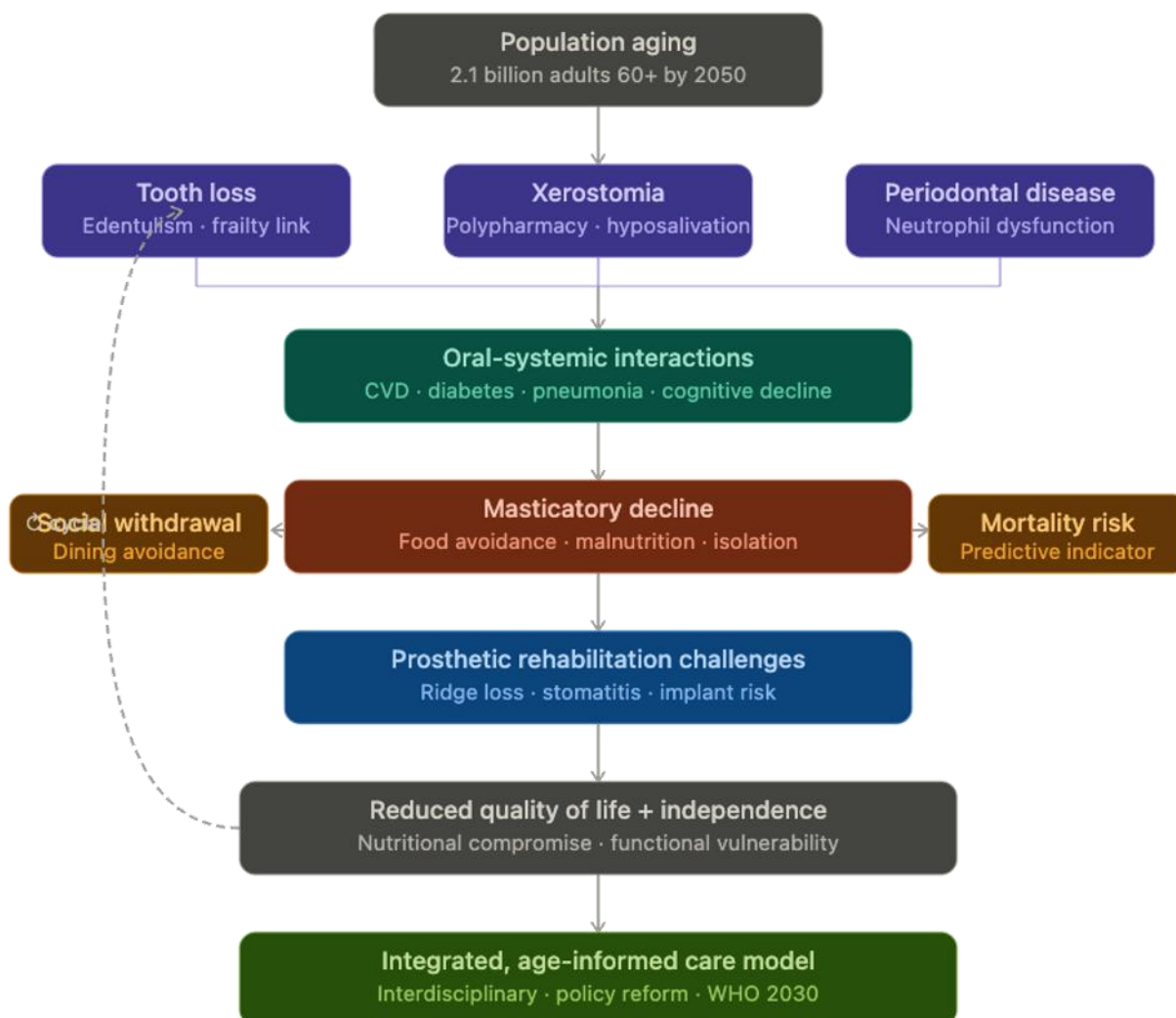


Figure 2: Clinical Cascade Flowchart [27,29-31].

Prosthetic Rehabilitation Challenges: Clinical and Patient-Centered Barriers

Prosthetic rehabilitation in older adults presents significant clinical challenges due to the frequent presence of oral alterations and systemic diseases that affect oral health and tissue response [31]. One of the most common conditions among removable denture wearers is denture stomatitis, which is associated with prolonged denture use, poor fit and biofilm accumulation primarily from the *Candida* genus. Poor oral hygiene promotes microbial colonization on prosthetic surfaces, while salivary factors such as flow rate, pH and composition influence its onset. Periodic clinical follow-up is therefore recommended for denture wearers, particularly for patients with compromised systemic health conditions [32,33].

Regarding structural changes in the edentulous patient, residual ridge resorption is a progressive process that can significantly influence the stability and success of prosthetic rehabilitation [34]. This loss of alveolar bone affects treatment outcomes and may alter clinical results depending on the type of prosthesis utilized. Evidence reveals differences across various rehabilitation modalities; however, results are not entirely consistent across studies, reflecting the heterogeneity present in the available literature [35].

Implant-supported overdentures have been extensively evaluated as an alternative to conventional complete dentures. In general, this modality improves retention, stability and masticatory function, contributing to a superior functional experience [36]. Improvements in patient satisfaction and oral health-related quality of life have also been observed. Nevertheless, the evidence demonstrates heterogeneity across studies attributable to methodological and assessment differences, which precludes the establishment of absolute superiority in all clinical scenarios. The indication for implant-supported overdentures must therefore be individualized based on the specific characteristics and systemic health of each patient [37,38].

Prosthetic rehabilitation in edentulous older adults has also been associated with improvements in masticatory function and dietary intake. Studies indicate that oral rehabilitation can increase the variety of foods consumed, particularly when accompanied by nutritional counseling [39]. However, the effects on systemic health show inconsistent results across studies, which limits broader conclusions regarding impact beyond the oral cavity [40].

Finally, periodontal management in older adults requires an individualized approach due to the biological, systemic and functional changes inherent to aging [41,42]. The presence of chronic diseases reduced salivary flow, alterations in wound healing and changes in bone metabolism can complicate periodontal treatment planning [43]. Furthermore, removable prostheses may promote plaque accumulation and contribute to the progression of periodontal disease in remaining teeth. Treatment planning must therefore account for the patient's medical conditions, oral hygiene capabilities and functional needs, prioritizing preventive strategies and long-term maintenance (Table 1) [40-43].

Domain	Primary Challenges	Recommended Approach
Oral-systemic bidirectionality	Periodontal pathogens drive CVD, diabetes dysregulation, cognitive decline and aspiration pneumonia	Integrate oral health assessment into medical evaluations; screen for periodontitis in cardiometabolic disease [8-15]
Polypharmacy / xerostomia	Medication burden reduces salivary flow, increases caries risk and compromises prosthetic retention	Medication review, salivary assessment, fluoride protocols, caries risk management, interdisciplinary communication [16-23]
Masticatory decline	Tooth loss and neuromuscular changes lead to dietary shifts, malnutrition, social withdrawal and increased mortality risk	Prosthetic restoration, oral function training, nutritional counseling, routine masticatory assessment in geriatric evaluations [24-31]
Prosthetic rehabilitation	Ridge resorption, denture stomatitis, poor implant candidacy, periodontal co-management, limited patient adaptability	Individualized treatment planning, implant-supported overdentures where indicated, regular maintenance, team-based care [32-36]

Table 1: Summary of key clinical challenges and evidence-based management strategies in geriatric oral rehabilitation [8,15,16,23,24,31,32,36].

Conclusions

Oral health in older adults is a complex issue influenced not only by clinical factors but also by systemic diseases, medication use, declining functional abilities and obstacles to prosthetic care. The burden worldwide is significant and increasing, with GBD 2021 data showing that a growing portion of oral-disease-related DALYs affects adults aged 60 and older, who mainly experience untreated cavities, advanced periodontitis and tooth loss. Periodontitis is a primary cause of edentulism and losing teeth often leads to poor nutrition and lower oral health-related quality of life. These issues are worsened by medication-induced dry mouth, the common belief among many healthcare providers that oral health is outside their responsibilities and notable gaps in dentists' training for geriatric patients.

Progress over the past three decades has been limited and meaningful improvement will depend on structural rather than incremental change. The main priorities are clear: integrating oral health providers into multidisciplinary geriatric care through interprofessional education and collaborative care models; standardizing geriatric oral health competencies across dental

curricula, drawing on frameworks such as the Age-Friendly 4M's and reforming coverage and policy, particularly the absence of comprehensive Medicare and Medicaid dental benefits for older adults in the United States. Embedding oral health within medical systems, updated clinical protocols and aging-focused public health frameworks will be indispensable to achieving the WHO Global Oral Health Action Plan target of a 10% reduction in oral disease burden by 2030.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The project did not meet the definition of human subject research under the preview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement

Not applicable.

Authors' Contributions

All authors contributed equally to this paper.

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