Acta Scientific MEDICAL SCIENCES (ISSN: 2582-0931)

Volume 9 Issue 6 June 2025

Review Article

The Connection Between Oral Frailty and Head and Neck Cancer: A Concise Review

Efsun Somay[1]*, Erkan Topkan[2], Sibel Bascil[3] and Ugur Selek[4]

[1]*Department of Oral and Maxillofacial Surgery, Baskent University, School of Dentistry, Ankara Turkey*

[2]*Deparment of Radiation Oncology, Baskent University Adana Turkey*

[3]*Department of Periodontology, Baskent University, School of Dentistry, Ankara,Turkey*

[4]*Deparment of Radiation Oncology, Koç University, School of Medicine, Istanbul Turkey*

***Corresponding Author:** Efsun Somay, Department of Oral and Maxillofacial Surgery, School of Dentistry, Baskent University, Ankara, Turkey.

DOI: 10.31080/ASMS.2025.09.2090

Received: April 16, 2025

Published: May 14, 2025

Abstract

Oral frailty (OF), which refers to a decline in oral functions, is an emerging concern in oncology, particularly among patients with head and neck cancer (HNC). Available evidence indicates that OF increases the risk of developing cancer and worsens the side effects of treatments, ultimately impacting survival rates and quality of life (QoL). OF is associated with various physiological changes, including reduced saliva production, impaired chewing ability, and poor oral hygiene, elevating the risk of developing HNC. A multidisciplinary approach is essential to address these challenges and improve patient outcomes. Chronic inflammation and an imbalance in the oral microbiome are key factors linking OF to HNC development and an increased risk of severe treatment-related toxicities. Hence, recognizing the limited data available on this critical topic, this review compellingly seeks to elucidate the multifaceted and complex relationship between OF and HNC in an evidence-based manner.

Keywords: Oral Frailty; Head and Neck Cancer; Survival

Abbreviations

HNC: Head and Neck Cancers; OF: Oral Frailty; RT: Radiotherapy; QoL: Quality of Life; ODK; Oral Diadochokinesis

Introduction

Head and neck cancers (HNC) refer to a diverse group of malignancies originating in the oral cavity, nasopharynx, oropharynx, hypopharynx, and larynx [1]. Although the overall incidence of HNC has been declining in many high-income countries over the past few decades, there is a notable increase in the prevalence of human papillomavirus-related carcinomas, particularly in the oropharynx, which has begun to reshape the demographic trends associated with these diseases [2]. This shift is particularly pronounced among younger populations, who are often less likely to engage in high-risk behaviors, such as tobacco use and excessive alcohol consumption, which are traditional risk factors for HNC [3]. Instead, the current trend shows an alarming increase in cases among older adults, many of whom also suffer from pre-existing health conditions (comorbidities) and physical frailty, which are linked to a higher risk of unfavorable health conditions, including malnutrition [4].

Frailty presents a significant public health challenge that profoundly affects individuals' quality of life (QoL), increases morbidity rates, and elevates mortality risk. Frailty is a clinical syndrome characterized by the gradual accumulation of deficits across various health domains, including physiological, nutritional, neurosensory, and cognitive functions. This multifaceted decline significantly reduces an individual's physiological reserves and impairs their ability to resist and respond effectively to endogenous and exogenous stressors [8]. In the context of an aging global

population, frailty has become increasingly recognized as a crucial indicator of health status in cancer patients. Studies have shown that frailty is associated with poorer treatment outcomes, increased risk of complications, and higher mortality rates. Consequently, there is a growing emphasis on assessing frailty to inform clinical decision-making and enhance patient-centered outcomes [9].

Oral frailty (OF), a specific type of frailty, refers to a collection of phenomena and processes that lead to changes in various oral conditions, such as the number of teeth, oral hygiene, and oral function, associated with aging. An increase in oral fragility results in reduced interest in oral health, diminished physical and mental reserve capacity, and eating disorders [10]. New research evidence on oral fragility emerges daily, and the definition of OF has broadened. For instance, OF, initially defined as oral health changes, seemed somewhat ambiguous; as evidence regarding the causes and consequences of OF has accumulated, it has become evident that aging is not the sole factor contributing to OF. Consequently, the impacts of OF extend beyond just increased oral sensitivity, and further clarification of OF is necessary [10].

However, an extensive literature search has revealed a notable absence of reviews that comprehensively evaluate the relationship between malnutrition risk and OF, particularly in HNC patients. This gap underscores the need for a thorough and systematic review of the existing literature on both subjects. Hence, the primary aim of this critical review is to synthesize and summarize the most relevant and up-to-date findings regarding the coexistence and interaction of malnutrition and oral frailty in patients with HNC. This review will delve into the underlying mechanisms, prevalence rates, and potential implications for patient care by examining various studies and clinical data.

Overview of oral frailty

In recent years, OF has been defined through several interrelated factors, including dental health, precisely the number of remaining teeth, self-reported chewing ability, physiological bite force, and dry mouth. Research has demonstrated that OF represents a complex condition characterized by compromised oral health, which can arise from disorders affecting essential components such as the teeth, oral mucosa, tongue, and salivary glands. These impairments significantly hinder vital oral functions, including chewing, swallowing, and speech production, which are critical for effective communication and proper nutrition [10]. For instance, a decreased bite force can lead to difficulties in processing food, while a dry mouth can exacerbate discomfort and hinder the swallowing process. Consequently, individuals suffering from oral frailty may experience a marked reduction in their food intake, potentially leading to inadequate nutrient absorption and subsequent health issues over time [10]. As a result, there has been considerable interest in exploring the intricate history of OF, which is fundamentally connected to overall systemic health and the coordination of physical and mental functions [11]. While a standardized clinical definition for OF remains elusive, utilizing it as an objective measure of health quality—considering elements such as dental status, gum health, and general oral hygiene—has garnered significant support from healthcare professionals and researchers alike [10,12].

The oral cavity is a dynamic structure encompassing dental, periodontal, and soft tissues, collectively facilitating essential oral functions. However, this balance may be adversely affected by aging, which is often associated with an increase in systemic diseases that impact oral health, such as diabetes, hypertension, and hyperlipidemia [12]. Furthermore, lifestyle factors, including dietary habits, medication use, stress levels, and physical activity, correlate with declining oral health. Consequently, the critical importance of maintaining oral function is receiving heightened attention, extending beyond the confines of disease-specific considerations. Individuals with compromised oral health may encounter difficulties performing fundamental activities such as chewing, swallowing, and speaking, leading to nutritional deficiencies and overall health complications [3]. The critical role of these functions in supporting nutritional intake is well-established, with a weak mastication capability linked to malnutrition [13]. In addition to physical health challenges, oral functional weakness can also exert significant implications for social interactions and mental well-being: patients experiencing poor oral function may hesitate to discuss their conditions, as they often perceive it as despicable. Unfortunately, this reticence can result in issues not readily addressed through dietary modifications or pharmacological interventions.

A comprehensive study by Chen., *et al*. identified a specific dashboard of oral function-related symptoms that significantly impact the responsiveness of patients with HNC to treatment

interventions and their overall nutritional status [16]. The symptoms outlined include excessive coughing while eating or drinking, which can lead to discomfort and aspiration risks; choking on food or beverages, which poses a serious safety concern; noticeable changes in the ability to speak or understand speech, potentially affecting communication with caregivers and loved ones; and experiencing shortness of breath or pain during meals, which can deter patients from maintaining adequate nutritional intake. Consequently, the authors advocated for a holistic and interdisciplinary approach that integrates nutritional support, speech therapy, and pain management strategies to optimize oral function and enhance the quality of life for these patients during and after oncological treatment. In their comprehensive study, Patel., *et al*. [20] underscored the notable discrepancies in dental health among patients diagnosed with HNC before radiotherapy. Their research revealed that these variations in dental health were significantly influenced by the specific cancer sub-regions involved, such as the oral cavity, oropharynx, and larynx. The authors asserted that there is an urgent need for individualized dental care plans specifically designed to address the unique requirements of each patient based on their cancer type and existing dental condition. Notably, the study also found that the average HNC patient presented with fewer than 21 teeth before the commencement of radiotherapy, which is distinctly below the functional dentition threshold typically required for effective oral health and function. This substantial loss of teeth is particularly concerning as it can lead to diminished oral functions, affecting biting, chewing, and speech capabilities. The authors emphasized that the adverse effects of additional tooth loss resulting from radiotherapy could exacerbate these oral function impairments, making it vital to monitor and support the oral health of HNC patients throughout and following their treatment. Consequently, since the factors mentioned above are a component of OF evaluations, addressing OF and mitigating related deterioration is crucial to enhancing these patients' overall quality of life during and after their treatment.

Oral frailty: definition and assessment

OF implies a compromised oral cavity and general health state, frequently associated with inadequate oral hygiene practices and systemic health issues [10]. The evaluation of OF encompasses several key factors, including oral dryness, individual healthcare behaviors such as routine dental visits, and the ability to swallow effectively. These factors collectively contribute to the gradual development of OF, impacting nutritional intake, speech functionality, and overall QoL. Hence, understanding the status of OF is crucial for implementing preventive and therapeutic strategies to enhance oral and systemic health. A multicentric study defined OF as meeting at least four of the following criteria [11,12]: 1) the use of dental prostheses or having fewer than 20 natural teeth, 2) experiencing subjective oral dryness, 3) receiving a daily oral healthcare behavior score of fewer than 25, 4) facing difficulties in speaking or pronunciation due to oral health issues, 5) displaying a lack of interest in oral health, and 6) never having undergone oral surgery, or have had fewer than two procedures in the past day. Notably, oral dryness, swallowing ability, and six categories of oral health were significantly associated with HNC, underscoring the importance of routine evaluation of OF—including social factors—in its management [12,21,22].

A large community-based cohort study from Stockholm, with a follow-up period over 44 years, showed that the number of lost teeth, the percentage of tooth surfaces affected by caries, and the plaque index were significantly linked to all-cause mortality [23]. These findings highlight the critical importance of maintaining good oral health, as improvements in dental hygiene and regular dental care may play a vital role in enhancing overall health and longevity. In this setting, Polzer and colleagues demonstrated that dental restoration to prevent tooth loss effectively reduces mortality rates [24]. A systematic review conducted by Dibello., *et al*. screened 68 eligible articles assessing eleven distinct oral health indicators, which included masticatory function, tongue pressure, occlusal force, oral diadochokinesis, dry mouth, overall oral health, periodontal disease, the number of teeth, as well as difficulties in chewing and swallowing, and issues related to tooth pain or loss [12]. Among the disorders related to chewing, swallowing, and salivation, difficulties in chewing were the most robust factors linked to an excess mortality rate of 16.22%. Hence, the authors concluded that various oral health indicators, encompassing the OF-related ones, are significantly associated with adverse health outcomes, including mortality, physical disability, functional disability, diminished quality of life, increased hospitalization, and higher incidences of falls among the elderly population [12]. Furthermore, another study has indicated that tooth loss is likely associated with increased mortality, physical weakness, and functional disability [25]. This study also highlighted the role of infectious agents such as Streptococcus sanguinis and

Actinobacillus actinomycetemcomitans in oral health, suggesting they may directly contribute to the development of atherosclerosis and thrombosis through inflammatory pathways. Additionally, a relationship has been proposed between inflammation, identified as a leading cause of tooth loss, and physical weakness [26]. Reports indicate that inflammation can diminish the protein synthesis capacity of muscles by elevating oxidative stress and insulin resistance, thereby increasing the risk of functional disability [27].

To date, Tanaka and colleagues have presented the only operational definition of OF, which identifies six key elements: the number of teeth, chewing function, chewing difficulties, oral diadochokinesis, tongue pressure, and swallowing difficulties. This definition indicates an increased risk of physical frailty, sarcopenia, functional disability, and all-cause mortality [28]. An additional definition of OF refers to the difficulty in chewing, known as presbyphagia, which is associated with age-related changes in swallowing [12,29].

Oral health is an essential component of an individual's overall health. A multidisciplinary approach is necessary to evaluate how oral health measures contribute to various health conditions. The number of teeth can be a valuable indicator of overall health, reflecting a person's accumulated experiences related to hygiene habits, the development of cavities, periodontal disease, and trauma over time. Maintaining or improving oral function is closely linked to better diet and overall functional status, which may help reduce the risk of death, disability, and other significant adverse health outcomes. This fact is especially critical for patients with HNCs, as oral health can directly impact survival and treatment results. Therefore, assessing OF as a determinant of oral health in their care is vital.

Components of oral frailty

AIRCRAFT is a mnemonic representing Anthropometry, Impression, Residual Ridge Anatomy, Mucous Membrane Condition, Functional Ability, and Tongue Shape [32]. It is commonly used to assess oral and prosthetic conditions comprehensively, especially in patients requiring prosthodontic rehabilitation. A masticatory ability score higher than 5 is considered essential for maintaining an adequate nutritional status. This scoring system has been used in HNC patients. Although many patients undergoing radiotherapy (RT) for head and neck cancers (HNCs) may achieve long-term survival, they are at significant risk of developing complications such as mucositis, dysphagia, xerostomia, and facial fibrosis. Additionally, airway obstruction associated with HNCs can impair the neuromuscular mechanisms that protect the airway during swallowing. This dysfunction may result in aspiration, which can be life-threatening and may require surgical intervention, often in the form of a tracheotomy [33].

The components of OF include: 1) Tooth Loss and Reduced Dentition: Fewer teeth can hinder effective chewing and proper oral function, 2) Diminished Masticatory Performance: The efficiency of chewing may decline due to tooth loss or reduced bite force, which can affect food processing and overall nutrition, 3) Lower Occlusal Force: A decrease in bite strength, often measured as reduced occlusal force, impairs the ability to break down food, 4) Decreased Tongue Pressure and Oral Motor Function: Weaker tongue strength and coordination, including tongue-lip motor skills, can lead to difficulties in swallowing, speech, and maintaining the proper position of dentures, if applicable, 5) Swallowing Difficulties (Dysphagia): Older adults may experience challenges with swallowing due to impaired oral motor function, which can negatively impact nutrition and increase the risk of aspiration, and 6) Poor Oral Hygiene and Salivary Function: A reduction in saliva flow and compromised oral hygiene can result in increased plaque buildup, periodontal disease, and deterioration of oral tissues [34]. These components significantly affect oral health, nutrition, social interactions, and QoL. Addressing each factor can help prevent further decline and promote better overall health.

OF impacts not only nutrition and QoL but also indicates a decline in various oral functions. These functions include tooth loss, decreased chewing performance, weakened tongue strength and coordination, swallowing disorders, and impaired salivary function. Additionally, HNC is linked to these issues in several ways [35]. First, chronic poor oral health, characterized by periodontal disease, tooth loss, and persistent infections, is associated with increased inflammation. Persistent oral inflammation has been linked to an increased risk of developing HNCs. In this context, the components of oral inflammation can serve both as indicators and contributing factors to the risk of HNC [36]. Additionally, treatments for HNC—such as surgery, RT, and chemotherapy—can worsen oral inflammation. For example, RT often leads to xerostomia (dry mouth), mucositis (inflammation and ulceration of the mucous

membranes), and a decrease in salivary flow [37]. These changes can impair chewing, swallowing, and overall oral function, further aggravating the condition of OF. Moreover, both HNC itself and the side effects of its treatment can create difficulties in mastication and swallowing, resulting in malnutrition and weight loss, which exacerbates OF and establishes a vicious cycle that hinders recovery and overall health [38]. Additionally, the combined challenges of OF and HNC can significantly impede speech, social interactions, and overall quality of life. Consequently, it is crucial to maintain or enhance oral function through timely dental care and rehabilitation for these patients. Poor oral health factors contributing to OF may increase the risk of developing HNC, while treatments for these cancers can further aggravate OF. This bidirectional relationship further underscores the importance of preventive dental care and early intervention to support oral function and overall health in at-risk populations.

Methods for assessing oral frailty

Frailty is often defined by a decline in physical status and a decrease in activity levels, which significantly increases an individual's vulnerability to various adverse health outcomes, such as heightened morbidity and mortality. In older adults, the evaluation of dental and oral functions has become increasingly recognized as a critical predictor of physical frailty and the potential loss of independence, as oral health greatly impacts nutritional intake, social interactions, and overall QoL [12,28]. Furthermore, oral function has surfaced as a pressing public health concern within rapidly aging societies, reflecting the complex relationship between oral health and overall well-being. Diagnosing and managing OF remains challenging, as there is currently no universally accepted definition of what constitutes OF. However, several rigorous studies have made efforts to identify, analyze, and classify OF in order to enhance preventive measures, inform nursing practices, and improve patient care strategies, thereby addressing an essential aspect of health maintenance in older populations. According to a study by Miyasato., *et al*. [39], oral function encompasses a mild decline in oral capabilities and cachexia or frailty in the oral structure. The authors noted that there is substantial evidence suggesting a connection between oral function and malnutrition, emphasizing that older individuals are particularly susceptible to malnutrition and weight loss due to their fragile nutritional intake [39]. A key aspect often considered in evaluations of oral function is the 2018 recommendation by the Japanese Geriatric Dentistry Association, which advises dentists to thoroughly assess, manage, and intervene in older adults' dental and oral functions [40].

In 2022, the Japan Geriatrics Society, the Japanese Society of Gerodontology, and the Japanese Association on Sarcopenia and Frailty formed the Joint Working Group on Oral Frailty to increase public awareness of this condition. The trends presented in their conference report, published by the Japanese Association for Dental Science, clarify the concepts of "oral health management" and "OF" [41]. According to this consensus report, the key difference between "age-related decline in oral function" and "OF" is based on the presence or absence of reversible factors during the progression of the condition. This distinction is crucial for developing effective intervention strategies, as acknowledging the existence of reversible elements in OF can lead to targeted therapies and preventive measures that enhance the quality of life of affected individuals. The Oral Frailty 5-item Checklist (OF-5), introduced here, is expected to serve as a vital tool for facilitating interventions related to oral health [42]. The OF-5 is designed to assess OF and can be administered without assistance from dental healthcare professionals, such as dentists or dental hygienists. Accordingly, OF is diagnosed by the presence of at least two of the following five components [42]: (i) a reduced number of teeth, (ii) difficulties in chewing, (iii) challenges in swallowing, (iv) a dry mouth, and (v) diminished articulatory oral motor skills (assessed through self-reported difficulty in clear pronunciation). The questions concerning three specific oral functions—difficulty in chewing, difficulty in swallowing, and dry mouth—were carefully selected from the Kihon Checklist, which is widely used in Japan to identify older individuals at risk of requiring long-term support or care (Table 1). The OF-5 assessment includes two objective indicators: "having fewer than 20 teeth" and "articulatory oral motor skills, evaluated through oral diadochokinesis." The OF-5 is administered using a specific questionnaire along with an oral diadochokinesis (ODK) test that measures the articulation of the "ta" syllable. This tool, which does not require any special equipment or techniques, is designed for versatile use within the community and aims to raise awareness about the deterioration of oral health at earlier stages. Utilizing this tool in medical institutions beyond dentistry is expected to enhance the prevention of OF through interdisciplinary

collaboration. This approach will facilitate various interventions to improve overall health and prevent the decline of eating skills among older adults living in the community. Ultimately, it seeks to reverse and prevent OF and support stable nutritional management.

Component	Questions	Response	
		Applicable	Not Applicable
Fewer teeth	How many of your natural teeth are left?	0-19 teeth	≥20 teeth
Difficulty in chewing	Do you have any difficulties eating tough foods compared with 6 months ago?	Yes	No
Difficulty in swallowing	Have you choked on your tea or soup recently?	Yes	No
Dry mouth	Do you often experience having a dry mouth?	Yes	No
Low articulatory oral motor skill	Have you had difficulty with clear pronunciation recently?	Yes	No

Table 1: Oral Frailty Five-Item Checklist.

The Oral Frailty Index-8 (OFI-8) is an 8-item screening questionnaire designed to evaluate oral health-related behaviors and concepts of OF [43] (Table 2). This tool was developed in consultation with experts in the field and focuses on three critical components of oral frailty: "tooth loss," "subjective chewing difficulties," and "subjective swallowing difficulties." The total score of the OFI-8 ranges from 0 to 11 points, where higher scores indicate poorer oral health. The questionnaire consists of eight yes-or-no questions that explore factors such as tooth loss, decline in general chewing ability, difficulties in swallowing, oral health-related habits, and reduced social participation. According to the OFI-8 scoring criteria, individuals are categorized as follows: "non-OF" indicates proficiency in all six criteria; "pre-OF" reflects inadequate performance in one or two criteria; and "OF" is defined by substandard performance in three or more criteria. This systematic approach enables a comprehensive assessment of oral health and levels of frailty.

Questions	Yes	No
Do you have any difficulties eating tough foods compared with 6 months ago?	2-point	
Have you choked on your tea or soup recently?	2-point	
Do you use dentures?	2-point	
Do you often have a dry mouth?	1-point	
Do you go out less frequently than you did last year?	1-point	
Can you eat hard foods like squid jerky or pickled radish?		1-point
How many times do you brush		1-point
Do you visit a dental clinic at least annually?		1-point

Table 2: Oral Frailty Eight-Item Checklist.

OF indexes are crucial in detecting and assessing declining oral function early. These indexes provide a comprehensive framework for evaluating important components, including tooth retention, masticatory performance, occlusal force, tongue strength, swallowing ability, and vital indicators of nutritional status and QoL. By quantifying these factors, healthcare professionals can more efficiently identify individuals at risk for further functional deterioration and systemic complications, particularly those associated with treatments for HNC. Integrating OF indexes into routine clinical practice may enable timely and targeted interventions, thus enhancing long-term patient outcomes through a holistic approach to oral and overall health needs.

Association between oral frailty and head and neck cancer

Recognizing the bidirectional relationship between health and disease has become foundational to patient-centered care. Within the oral cavity, a complex interplay among various structures and functions—such as the tongue, teeth, gums, and salivary glands—works together to enable essential activities, including breathing, chewing, speaking, and digestion. The state of one's oral health is not merely indicative of local conditions; it serves as a vital reflection of one's overall health status, influencing systemic well-being and QoL. In particular, HNC and oral functions are known to adversely affect each other, significantly complicating both disease progression and treatment outcomes. Treatments for primary HNC, such as surgery, RT, and chemotherapy, often lead to debilitating sequelae that impair oral function, resulting in difficulties with chewing and swallowing. This underscores the necessity for a holistic and interdisciplinary approach that integrates dental care, nutrition, psychology, and rehabilitation to optimize oral function and enhance QoL. Moreover, in HNC patients, swallowing ability and depression have been identified as the most critical determinants affecting dysphagia-specific health-related QoL. The challenges associated with swallowing—often exacerbated by treatment-related toxicity—combined with the emotional toll of a cancer diagnosis, can profoundly impact patients' overall QoL. Thus, addressing both the physical and psychological aspects of care is essential for improving outcomes for these individuals.

Poor oral health contributes to a prolonged inflammatory state within the oral cavity. This chronic inflammation, driven by periodontal disease, persistent infections, and inadequate oral hygiene, can result in increased and uncontrolled cellular turnover, DNA damage, and alterations in the tissue microenvironment, thereby fostering carcinogenic conditions [44]. The compromised ability to chew may affect nutritional intake and immune function, which in turn exacerbates systemic inflammatory responses. These interconnected processes indicate that OF not only reflects poor oral hygiene but may also actively facilitate the initiation and progression of malignant changes in the head and neck region. Additionally, treatment modalities for HNC, particularly RT, may worsen preexisting OF, thereby establishing a bidirectional relationship between these two issues. RT, for instance, frequently leads to adverse conditions such as xerostomia, mucositis, and decreased salivary flow, all of which can further compromise essential oral functions like chewing and swallowing. These detrimental effects may result in nutritional deficiencies and a reduced capacity for tissue repair, exacerbating the OF. Additionally, the resulting neuromuscular impairments and altered oral biomechanics can impede the adequate clearance of toxic substances, potentially sustaining or even intensifying the inflammatory processes predisposing tissues to malignancy. Consequently, the mechanisms driving OF and the adverse effects of treatments for HNC intersect to create a complex scenario highlighting the necessity for early intervention and tailored management strategies in patients at risk for or currently receiving treatment for HNC.

The field of head and neck oncology has grown increasingly complex, with an expanding body of evidence on prognostic factors related to "treatment gerontology," as well as side effects, diagnostic methods, biological therapies, and advancements in surgical techniques, including microvascular reconstruction. In this intricate landscape, the collaboration between oncologists and geriatricians has become increasingly vital. Geriatricians bring specialized knowledge in assessing frailty, encompassing various factors such as physical health, cognitive function, and overall resilience. By accurately evaluating these elements, healthcare providers can tailor treatment plans that address the cancer and consider the patient's overall well-being and QoL.

Nonetheless, two research questions remain under investigation: (i) is there evidence that supports an association between oral health and the risk of HNC, and (ii) is there evidence that supports an association between oral health and the risk of HNC in individuals who are frail or at an increased risk of frailty? Translational research is advancing rapidly, particularly with

innovations in mobile breath monitoring for dietary tracking and improving prognostic accuracy for cancer patients. The multidisciplinary nature of this research project underscores its extensive reach and the integration of various competencies involved in driving innovation and procedural enhancements. The relationship between oral function and HNC has not been thoroughly explored. Nonetheless, it is anticipated that HNC incidence will rise among individuals aged 65 and older, a demographic already facing numerous degrees of disability, including chewing and swallowing difficulties, trismus, speech disorders, and xerostomia, which can occur as both early and late complications of treatment and disease progression [45]. Moreover, it is conceivable that impaired oral function may exacerbate these disabilities in older patients. Thus, while this connection has not yet been studied, there is a plausible potential relationship that merits further investigation.

Several strategies can be proposed to mitigate the impact of oral function on HNC genesis and outcomes. First, it is crucial to encourage patients to adopt comprehensive oral hygiene practices. This includes brushing at least twice daily with fluoride toothpaste, daily flossing to remove plaque between teeth, and scheduling routine dental checkups every six months. These practices can significantly reduce the risk of tooth decay and gum disease, which may contribute to the onset of HNC. Additionally, implementing national screening programs in high-risk populations can lead to earlier detection of OF. Early identification of signs of OF may significantly improve treatment outcomes and survival rates for patients diagnosed with HNCs. Furthermore, fostering collaboration among healthcare professionals—including oncologists, dentists, nutritionists, and speech therapists—is essential in delivering holistic care that addresses the OF, oncological treatment, and the functional rehabilitation of patients. Such interdisciplinary teamwork can help prevent and/or manage severe side effects, improve nutrition during treatment, and restore speech and swallowing functions post-treatment. Lastly, increasing public awareness about the signs and symptoms of OF with their possible links to HNC and treatment-related toxicities can empower patients to seek medical attention promptly. Educational initiatives could include community workshops, informational brochures, and outreach programs targeting at-risk individuals, promoting early intervention, and improving health outcomes.

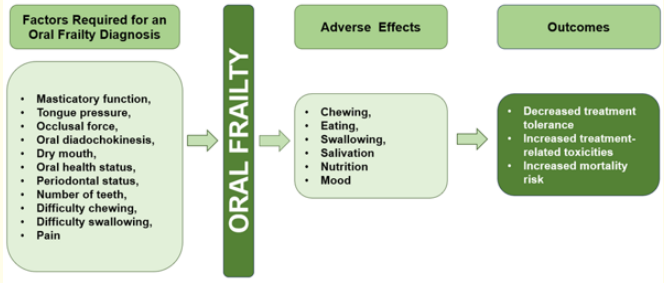

Figure 1: Oral Frailty effects on head and neck cancer patients.

Conclusion and Future Directions

As longevity increases among populations, there is a discernible rise in the number of patients diagnosed with HNC in later stages of life. Independent of age, prevalent dose-dependent side effects—including difficulties in swallowing, dysphagia, dry mouth (xerostomia), compromised dental health, and persistent oral symptoms—have a considerable negative impact on the overall health and QoL for patients with HNC following treatment. Mounting evidence suggests a strong association between the development of HNC and related clinical outcomes. and specific frailty states, including the OF. Furthermore, frailty is correlated with adverse treatment outcomes, including heightened surgical risks and diminished overall QOL in these patients. OF, a specific type of frailty, encompasses a multi-dimensional pre-motor state characterized by a decline in oral functions, including those related to swallowing, daily living activities, and gross orofacial motor skills. These functions are crucial for patients undergoing treatment for HNC, as they directly impact the ability to consume adequate food and fluids, swallow bodily secretions, and maintain oral hygiene. Given the significant impact of OF on treatment tolerance and outcomes in HNC patients, it is crucial that diagnostic, preventive, and therapeutic strategies are approached through a multidisciplinary lens. This approach should involve collaboration among experts from various fields, including dentistry, which can address oral health and hygiene; otolaryngology, focusing on the management of head and neck structures; medical oncology, which oversees systemic cancer therapies; and radiation oncology, which is responsible for localized treatments. Additionally, the involvement of nutrition specialists is essential to ensure that patients maintain adequate nutritional intake, which can be

compromised during treatment. Rehabilitation professionals can provide vital support for recovery, focusing on speech, swallowing, and overall functional improvements. By integrating these diverse areas of expertise, the comprehensive care of HNC patients can be significantly enhanced, leading to better tolerance of treatments and improved overall outcomes.

Acknowledgements

Not Applicable.

Conflict of Interest

The authors declared that they have no conflict of interest.

Bibliography

1. Johnson DE., *et al*. "Head and neck squamous cell carcinoma". *Nature Reviews Disease Primers* 6.1 (2020): 92.

2. Lechner M., *et al*. "HPV-associated oropharyngeal cancer: epidemiology, molecular biology and clinical management". *Nature Reviews Clinical Oncology* 19.5 (2022): 306-327.

3. Dewansingh P., *et al*. "Malnutrition risk and frailty in head and neck cancer patients: coexistent but distinct conditions". *European Archives of Oto-Rhino-Laryngology* 280.4 (2023): 1893-1902.

4. Moon S., *et al*. "Malnutrition as a major related factor of frailty among older adults residing in long-term care facilities in Korea". *PLoS One* 18.4 (2023): e0283596.

5. Tański W., *et al*. "Association between Malnutrition and Quality of Life in Elderly Patients with Rheumatoid Arthritis". *Nutrients* 13.4 (2021): 1259.

6. Parrettini S., *et al*. "Nutrition and Metabolic Adaptations in Physiological and Complicated Pregnancy: Focus on Obesity and Gestational Diabetes". *Frontiers in Endocrinology (Lausanne)* 11 (2020): 611929.

7. Andres SF., *et al*. "Building better barriers: how nutrition and undernutrition impact pediatric intestinal health". *Frontiers in Immunology* 14 (2023): 1192936.

8. Chen X., *et al*. "Frailty syndrome: an overview". *Clinical Interventions in Aging* 9 (2014): 433-441.

9. Mendes ML., *et al*. "Frailty and risk of complications in head and neck oncologic surgery. Systematic review and dose-response meta-analysis". *Medicina Oral, Patologia Oral, Cirugia Bucal* 26.5 (2021): e582-e589.

10. Zhao H., *et al*. "Oral frailty: a concept analysis". *BMC Oral Health* 24.1 (2021): 594.

11. Yan GLK., *et al*. "Functional Dentition, Chronic Periodontal Disease and Frailty in Older Adults-A Narrative Review". *International Journal of Environmental Research and Public Health* 20.1 (2022): 502.

12. Dibello V., *et al*. "Oral frailty and its determinants in older age: a systematic review". *Lancet Healthy Longevity* 2.8 (2021): e507-e520.

13. Iwasaki M., *et al*. "The association of oral function with dietary intake and nutritional status among older adults: Latest evidence from epidemiological studies". *Japanese Dental Science Review* 57 (2021): 128-137.

14. Shimizu A., *et al*. "Impact of Poor Oral Health Status on Swallowing Function Improvement in Older Dysphagic Patients". *Cureus* 15.12 (2023): e51249.

15. Ortíz-Barrios LB., *et al*. "The impact of poor oral health on the oral health-related quality of life (OHRQoL) in older adults: the oral health status through a latent class analysis". *BMC Oral Health* 19.1 (2023): 141.

16. Chen SC. "Oral Dysfunction in Patients With Head and Neck Cancer: A Systematic Review". *Journal of Nursing Research* 27.6 (2019): e58.

17. Somay E., *et al*. "The impact of radiation-induced trismus on patients' life quality". *Archives of Current Research International* 22.5 (2022): 12-24.

18. De Cicco D., *et al*. "Health-Related Quality of Life in Oral Cancer Patients: Scoping Review and Critical Appraisal of Investigated Determinants". *Cancers (Basel)* 13.17 (2021): 4398.

19. Dzebo S., *et al*. "Quality of Life of Patients with Oral Cavity Cancer". *Material Sociomedicine* 29.1 (2017): 30-34.

20. In 't Veld M., *et al*. "Oral-Functioning Questionnaires in Patients with Head and Neck Cancer: A Scoping Review". *Journal of Clinical Medicine* 12.12 (2023): 3964.

21. Patel V., *et al*. "Presenting pre-radiotherapy dental status of head and neck cancer patients in the novel radiation era". *British Dental Journal* 228 (2020): 435-440.

22. Pan MY., *et al*. "Prevalence of and factors associated with fewer than 20 remaining teeth in Taiwanese adults with disabilities: a community-based cross-sectional study". *BMJ Open* 7.10 (2017): e016270.

23. Jansson L., *et al*. "Mortality rate and oral health - a cohort study over 44 years in the county of Stockholm". *Acta Odontologica Scandinavica* 76 (2018): 299-304.

24. Polzer I., *et al*. "The association of tooth loss with all-cause and circulatory mortality. Is there a benefit of replaced teeth? A systematic review and meta-analysis". *Clinical Oral Investigation* 16 (2012): 333-351.

25. Mattila KJ., *et al*. "Role of infection as a risk factor for atherosclerosis, myocardial infarction, and stroke. *Clinical Infectious Disease* 26 (1998): 719-734.

26. Soysal P., *et al*. "Inflammation and frailty in the elderly: a systematic review and meta-analysis". *Ageing Research Review* 31 (2016): 1-8.

27. Ali S., *et al*. "Sarcopenia, cachexia and aging: diagnosis, mechanisms and therapeutic options - a mini-review". *Gerontology* 60 (2014): 294-305.

28. Tanaka T., *et al*. "Oral frailty as a risk factor for physical frailty and mortality in community-dwelling elderly". *Journals of Gerontology Series A* 73 (2018): 1661-1667.

29. Watanabe Y., *et al*. "Oral health for achieving longevity". *Geriatrics and Gerontology International* 20 (2020): 526-538.

30. Wakabayashi H. "Presbyphagia and sarcopenic dysphagia: association between aging, sarcopenia, and deglutition disorders". *Journal of Frailty Aging* 3 (2014): 97-103.

31. World Health Organization. "WHO global report on falls prevention in older age" (2014).

32. Leopardi A. "Complete Dentures: Achieving Superior Anterior Esthetics and Post-Delivery Maintenance". *Inside Dentistry* (2009).

33. Eisbruch A., *et al*. "Dysphagia and aspiration after chemoradiotherapy for head-and-neck cancer: which anatomic structures are affected and can they be spared by IMRT?" *International Journal of Radiation Oncology, Biology, Physics* 60.5 (2004): 1425-1439.

34. Iwasaki M., *et al*. "A Two-Year Longitudinal Study of the Association between Oral Frailty and Deteriorating Nutritional Status among Community-Dwelling Older Adults". *International Journal of Environmental Research and Public Health* 18.1 (2021): 213.

35. Kusunoki H., *et al*. "Oral Frailty and Its Relationship with Physical Frailty in Older Adults: A Longitudinal Study Using the Oral Frailty Five-Item Checklist". *Nutrients* 17.1 (2024): 17.

36. Nishi H., *et al*. "Head and neck cancer patients show poor oral health as compared to those with other types of cancer". *BMC Oral Health* 23.1 (2023): 647.

37. Naidu MU., *et al*. "Chemotherapy-induced and/or radiation therapy-induced oral mucositis--complicating the treatment of cancer". *Neoplasia* 6.5 (2004): 423-431.

38. Dewansingh P., *et al*. "Malnutrition risk and frailty in head and neck cancer patients: coexistent but distinct conditions". *European Archives of Oto-Rhino-Laryngology* 280.4 (2023): 1893-1902.

39. Miyasato K., *et al*. "Oral Frailty as a Risk Factor for Malnutrition and Sarcopenia in Patients on Hemodialysis: A Prospective Cohort Study". *Nutrients* 16.20 (2024): 3467.

40. Minakuchi S., *et al*. "Oral hypofunction in the older population: position paper of the Japanese Society of Gerodontology in 2016". *Gerodontology* 35 (2018): 317-324.

41. Report of the Conference on the Establishment of Definitions for "Oral Health Management" and "Oral Frailty". (2023).

42. Tanaka T., *et al*. "Oral frailty five-item checklist to predict adverse health outcomes in community-dwelling older adults: A Kashiwa cohort study". *Geriatrics and Gerontology International* 23.9 (2023): 651-659.

43. Tanaka T., *et al*. 'Oral Frailty Index-8 in the risk assessment of new-onset oral frailty and functional disability among community-dwelling older adults". *Archives of Gerontology and Geriatrics* 94 (2021): 104340.

44. Rajasekaran JJ., *et al*. "Oral Microbiome: A Review of Its Impact on Oral and Systemic Health". *Microorganisms* 12.9 (2024): 1797.

45. Mitus-Kenig M., *et al*. "Comparison of Oral Health Impact Profile (OHIP-14) Values in Cancer Survivor Patients Treated Orthodontically with Either Rapid or Standard Duration Protocols of Treatment-A Prospective Case-Control Study". *International Journal of Environmental Research and Public Health* 17.23 (2020): 9068.