

ORAL AND PERIORAL PHYSIOLOGICAL CHANGES WITH AGEING

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ABSTRACT

Ageing is the accumulation of changes over time. Ageing in humans is a multidimensional process including physical and psychosocial changes. Therefore, the management of the oral problems in elderly patients does not depend on the development of new technical skills, but rather on the overall knowledge of age-related and disease-related changes. Moreover, the dentist should be aware of the different modification necessary in the practice to prevent, diagnose and manage different oral conditions in the geriatric patient. Thus, the aim of this article is to gather the oral changes including salivary gland and saliva, tongue and oral sensation, lips, perioral tissues with ageing to enhance dentist's overall knowledge associated with these changes.

Key words: Oral, Dental, Physiological changes, Ageing.

INTRODUCTION

Geriatric medicine deals with the social, psychological and clinical aspects of diseases in older individuals. However, geriatric dentistry refers to dealing with oral diseases in old individuals including prevention and treatment.¹ Ageing is the accumulation of changes over time. Ageing in humans is a multidimensional process including physical and psychosocial changes. The decline in oral health such as limitation of oral cavity function due to oral disease, tissue damage, and pain leading to the avoidance of certain daily activities.² The elderly are at greater risk for developing oral disease since gains in longevity result in more medically compromising conditions or systemic disease with oral manifestations.³ Therefore, most oral changes experienced by the elderly are not the result of ageing process itself, but are the consequences of systemic diseases, pharmacotherapy, functional disabilities, and cognitive impairment. Thus, the management of the oral problems in elderly patients does not depend on the development of new technical skills, but rather on the knowledge of biological, psychological and social aspects of age-related changes and disease-related changes; and the role of an interdisciplinary team.^{4,5}

Research on the oral health status of elderly populations has been limited in frequency and scope. However, lingual varicosities, glossitis, and atrophy of the taste buds and of the salivary glands, with variable degrees of xerostomia, periodontal disease and in-

creased risk to develop malignancies have all been reported with ageing.^{6,7,8} Furthermore, dental changes including abrasion, attrition and caries increase with ageing.⁹ In addition, there is a lack of good descriptive and longitudinal data on saliva and salivary gland function, tongue and oral sensation status, and lips and perioral tissue changes with ageing. Thus, the aim of this article is to review the oral changes including salivary gland and saliva, tongue and oral sensation, lips, perioral tissues with ageing.

Salivary gland and saliva

Xerostomia is a symptom associated with a variety of causes. Disorders in the production and transport as well as excessive depletion of saliva may lead to xerostomia. Moreover, only a small percentage of the patients suffer from xerostomia with a known etiology such as Sjögren's syndrome or as a result of radiotherapy, however, the etiology of xerostomia in the majority of cases is assumed to be age related, disease related, various medications and drugs related or idiopathic.¹⁰ Xerostomia is one of the contributing factors to the decrease in sensitivity of the taste buds, increase in dental caries, inability to wear dentures, and burning sensation in the mouth of many elderly.^{11,12} It is difficult to make any general statement about the functional changes of salivary gland associated with ageing as the clinical evidence is controversial and data from different studies do not encourage any uniform conclusion. Nagler RM et al¹³ reported that

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salivary flow rates and total amount of salivary components are reduced in the elderly. Similarly, Ship JA et al reported that body dehydration is associated with decreased parotid salivary gland flow rates, and that these changes are generally age-independent in healthy adults. Furthermore, although subjects were rehydrated unstimulated salivary flow rates remained significantly lower than baseline levels.¹⁴ Piantanelli L et al reported that the beta-adrenoceptor alteration during ageing may play a major role in the age-dependent impairment.¹⁵ In addition, Kousvelari EE et al suggested that the reduction of activity in the pathway responsible for asparagine-linked protein glycosylation may cause age-dependent impairment of the gland activity.¹⁶ In contrast, Challacombe SJ et al reported that no significant changes in the secretion rates in parotid saliva were found with age.¹⁷ In addition, Nolan NE et al showed that the major salivary gland output is aged-stable in healthy geriatric and suggest that salivary gland dysfunction in an older person should not be considered as a normal process of ageing.¹⁸ Vissink A et al reported that no age-related changes were observed in the secretion of saliva. However, some age-related changes occur in the organic composition of saliva.¹⁹

Mucosal infections account for the majority of infections seen in elderly people but little is known of whether mucosal immunity decreases with age. Salivary protein interactions with oral microbes include aggregation, adherence, cell-killing, inhibition of metabolism and nutrition. Therefore, oral ecology may be influenced by such interactions.²⁰ However, inconsistent results have been obtained with the hypothesis that quantitative variation in salivary protein concentrations can affect oral disease prevalence. Challacombe SJ et al showed a significant reduction in the secretion rates of IgA and IgM, but not IgG, in whole saliva with increase age which may contribute to the increased susceptibility of elderly individuals to oral infectious diseases.²¹ In addition, Percival RS et al showed an age-related change in salivary antibodies with decrease in IgG and IgM antibodies. However, salivary IgA levels showed increase with age. Therefore, the ability to form IgA antibody is not impaired with increased age and that secretion rates and functional properties of antibodies may be as important as concentrations in protection against mucosal infective diseases.²² Vissink A, et al showed that the concentration of sIgA in labial saliva and the concentrations of high-molecular and low-molecular mucins in mucous saliva are reduced with age.²³

Salivary glands in aged humans and experimental animals have been examined in order to characterize the functional and structural changes with ageing. Furthermore, a wide range of different structural changes have been described involving both the parenchymal and stromal tissues. However, it is unclear how the function of the salivary glands could be affected by any of these changes. Kim SK et al reported a reduction in the volume of acini with a concomitant increase in the ductal volume.²⁴ Similarly, Vissink A et al reported a reduction in the volume of acinar tissue in parotid gland and increase in fatty and fibrous tissue with ageing.²³ Similarly, Drummond JR et al reported an increase in fibro-fatty tissue within the parotid gland with ageing.²⁵ Azevedo LR et al reported that ageing process in sublingual glands starts with acinar atrophy, followed by the presence of duct-like structures and ends with the replacement of the parenchyma by fibrous and/or adipose tissue. Moreover, the mononuclear infiltrate changes from focal to diffuse and no difference in the ageing of the sublingual glands was observed between men and women.²⁶ Kikuchi K, et al reported that the rat sublingual gland accumulates amyloid protein in the parenchyma and changes the properties of secretory granules of the acinar cells in the serous demilune with ageing. However, apoptosis of the parenchymal cells and the decrease of the gland weight were slight.²⁷ Mahay S et al reported infiltration of lipids and mast cells of the parotid gland and decrease in amylase release and cytosolic Ca²⁺ signals with ageing.²⁸ Furthermore, Martinez-Madrigal F et al reported the ageing changes including oncocyte proliferation, fatty infiltration, squamous and mucous metaplasia, hyperplasia, atrophy, and regeneration.²⁹ In addition, Scott J. et al reported that increasing incidence of obstructive foci with ageing which contribute to the gradual reduction in parenchyma in the human submandibular gland.³⁰

Tongue and oral sensation: Dysphagia, difficulty in eating or drinking, appears to increase with age and is a concern for our growing elderly population. Mastication, tongue mobility, and lip closure are skills of the oral phase of ingestion and have been shown to deteriorate with age.³¹ Crow HC et al showed that the change in tongue function is gender and age dependent and follows the same trends as change in hand function with ageing leading to decrease in strength in older individuals and females, however, tongue endurance is gender- and age-independent.³² Furthermore, Steele CM, et al showed a stereotyped pattern of tongue movement change with ageing in human during swal-

lowing with effects on movement duration.³³ Robbins J et al showed that swallowing pressures decline with age leading older people to work harder to produce adequate swallowing pressure and increasing the risk of developing dysphagia.³⁴ Hirai T et al investigate tongue skill including upward and downward tongue movements with two constant frequencies using an ultrasound system in young and elderly adults and showed that upward and downward movement rhythms in the elderly were more irregular than those of young adults. In addition, the velocity of tongue upward and downward movements were statistically decreased in the elderly revealing a different oral motor behavior in the elderly compared to young adults.³⁵ Furthermore, Yoshikawa M et al showed that swallowing functions deteriorate even in healthy dentate elderly persons.³⁶

Animal study showed that sufficient tongue force was generated by old animals. However, old animals were slower in achieving these forces than young animals. These findings are consistent with reports of altered tongue actions during swallowing in humans and suggest that a disruption in the timing of muscle contraction onset and recovery may contribute to the altered tongue kinetics observed with ageing. In addition, fatigability and maximum tongue forces were not altered significantly with ageing. However; longer half-decay recovery time intervals and longer twitch contraction time were significantly changed with ageing.³⁷

Physiological anorexia, decreased dietary variation, and weight loss associated with poor health are common conditions in the elderly population, with changes in chemosensory perception as important contributing causes. Taste receptor cells (TRCs) represent a unique opportunity to study a dynamic population of excitable cells that undergoes two basic neurobiological processes, development and cell turnover.³⁸ Nordin S et al showed an age-related loss in identification for citric acid and quinine-hydrochloride which was more pronounced than the age-related loss in identification for sucrose and NaCl at both the tip and midlateral regions but not at the posteromedial region.³⁹ In addition, Sugimoto K et al showed that the sensitivity of taste cells to quinine increases with their ageing but the sensitivity to sucrose decreases.⁴⁰ Furthermore, Winkler S et al showed that salt and bitter taste acuity declines with age, but sweet and sour perceptivity does not change with ageing.⁴¹ Fukunaga A et al showed that ageing affects taste perception and oral somatic sensations differently with significant

age-associated deterioration in taste. This suggests that decreased taste perception of foods with ageing may be caused primarily by perceptual loss of taste among oral sensations.⁴² Furthermore, Smith CH et al showed deterioration in viscosity perception with ageing which was more pronounced in male than female.⁴³ An animal study showed that the aged mice demonstrated a delayed cell renewal and highly vacuolated cytoplasm in taste receptors leading to decline in taste sensitivity with ageing.⁴⁴ Thus, the taste sensitivities to change with age throughout life and they decline with ageing and these findings may have implications for food preferences and the diets of elderly people.

Oral sensation including two-point discrimination, oral stereognosis, vibrotactile detection, somesthetic sensitivity, proprioception, and thermal sensitivity has been observed in old and young age. Calhoun KH et al showed that thermal, somesthetic sensitivity and proprioception did not change with ageing. In addition, ability for vibration detection on the soft palate and stereognostic ability did not change. However, two-point discrimination deteriorated on the upper lip, on the cheeks and on the lower lip with ageing. In contrast, two-point discrimination on the tongue and palate did not change with ageing.⁴⁵ In addition, Winkler S et al showed a considerable difference between elderly people and young people in regards to sensory perception.⁴¹ Furthermore, glossodynia or burning tongue is a common complaint of the aged individuals.¹² Tongue anatomy and histology showed changes with ageing. Scott et al showed that the mean epithelial thickness decreases with ageing and the progenitor cell layer remained of constant thickness, however, it's nuclear / cytoplasm ratio reduced significantly. In addition, significant reductions occurred in the rete surface area of the lateral epithelium and in the papillary surface area of the dorsal epithelium. Therefore, the overall pattern of ageing in the lingual epithelium suggested a continuous trend towards atrophy and simplification of structures with ageing.⁴⁶ In addition, fissuring of the tongue with the dorsal surface changes in texture that begins with minor atrophy of the filiform papillae at the tip to a completely smooth lacquered tongue has been reported with ageing.¹² Moreover, Semba I showed a histopathological alteration in the lingual arterial wall with progressing age which suggests that disturbances of homeostasis play an important role in age-related progression of arteriosclerotic change.⁴⁷ One further change in the tongue is the increase in tongue size (macroglossia) with

ageing. Macroglossia can occur as a result of congenital problem or tumors. However, it is more due to a combination of loss of muscle tone and expansion to fill the oral cavity space as teeth are lost in old individuals.⁴⁸

Lips: Lips and perioral skin has also importance in associated oral cavity functions. However, there are few descriptions of the age-related changes taking place in this zone. Desai S et al showed that the smile gets wider transversely and narrower vertically with ageing. In addition, the dynamic measures showed that the muscles' ability to create a smile decreases with ageing.⁴⁹ Penna V et al showed a statistically significant thinning of the orbicularis oris muscle and thinning of the cutis using a histomorphometric analysis. In addition, an increase of the orbicularis oris muscle angle defining the vermilion border in the old lip was observed. Furthermore, degeneration of the elastic and collagen fibers in the cutis was observed with ageing. However, the orbicularis oris muscle is not subject to fatty or fibroblastic degeneration, but shows signs of atrophy.⁵⁰ Dehail P et al showed a decrease in the lower limb muscle strength with ageing using isokinetic assessment method.⁵¹ Lévêque JL et al showed that the wrinkle number and visibility are linearly related to age and becoming more visible at the fifth decade. Furthermore, the lip height decreases and intercommissural distance increases with ageing.⁵² Although older adults are subject to both subtle changes and major disorders of the oral sensorimotor system, relatively little is known about lip sensory function changes with ageing. Wohlert AB et al showed that spatial acuity at the lip vermilion declines significantly with ageing and that women tend to have better acuity than men. In addition, marginal changes in lip tissue composition and receptor density may be the causes for the age-related decline in sensation.⁵³

Various lips in senescent humans and other animals have been examined extensively to characterize the structural and functional changes that occur during ageing. Ferraris ME et al showed a modification in the chemical composition and at cytological level of the secretory granules of the labial salivary glands leading to functional variations with ageing.⁵⁴ In addition, Yanagi K et al showed using Fontana-Masson argentaffin stain and S-100 protein immunoreactivity that the mean number of mucosal melanocytes increased gradually with ageing in men. In addition, the change may play a role in development of melanocytic lesions such as malignant melanomas, pigmented nevi, and senile lentigo.⁵⁵

CONCLUSION

Oral and perioral tissues including salivary glands, tongue, oral sensation and lips undergo different functional and structural changes with ageing. Therefore, the dentist should be aware of the different modification necessary in the practice to prevent, diagnose and manage different oral conditions in the geriatric patient, therefore, enabling a large portion of the world's population to enjoy far better oral health. In addition, the dentist should be aware of the changes occur in the upper lip, lower lip and saliva with ageing that act to fail or mask otherwise esthetic dental procedures including dental implants, gingival esthetic surgery, optimal dental restorations and removable or fixed denture.

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