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Review Article

How masticatory function and periodontal disease relate to senile dementia



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Summary This study reviews the research of dementia, a pathology for which numerous studies have found associations with masticatory function in the elderly. These issues are presently major problems in geriatric medical and welfare settings, and we discuss the prospects for future research into mastication. Dementia and masticatory function have been examined in a range of epidemiological and neuroscientific studies, and associations between the two have been reported. However, a causal relationship has not been satisfactorily established. Biochemical studies have also clarified the basis of the association between dementia and periodontal disease, but have not yet yielded sufficient evidence. Studies offering a high level of evidence, such as intervention studies and meta-analyses, are expected to be undertaken in this area in the future. Maintenance and recovery of masticatory function is of great importance with respect to achieving healthy longevity. Dental science will have considerable obligations and will have to take on an important role in this regard. For dental treatment to take on such important roles in the fields of health, medicine and welfare, it is necessary to provide information that will be understood not just by other medical and healthcare professionals, but also by the general public.

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1. Introduction

Japan has become a super-aged society, reaching this situation before any other country [1]. The 2012 Survey of Dental Diseases found that the proportion of elderly individuals with at least 20 of their own teeth at 80 years of age was 38.3% [2]. At the same time, an increase has been seen in the number of elderly people who have many of their own teeth but have decreased masticatory function [3]. Masticatory function may therefore be conjectured to be affected not only by reductions in the number of teeth, but also by increasing age [4].

Mastication, in which food is crushed and mixed with saliva to form a bolus for swallowing, is a complex process involving the repeated opening and closing of the jaw, the secretion of saliva and the mixing of food with the tongue. Mastication is a rhythmic, automatic movement similar to breathing or walking, and is a characteristic movement that can intentionally be made faster, slower or even stopped [5]. In addition, mastication and swallowing of solid food differs from command swallowing of fluid or semi-solid food. With solid food, the masticated bolus is transported to the oropharynx (stage II transport) before the swallowing reflex begins, and bolus formation within the mouth continues. This transport to the oropharynx is not gravity-dependent, but takes place as a result of active movement of the tongue during mastication. The bolus sent to the pharynx is swallowed while the next bolus is masticated in the mouth and then is sent to the pharynx. Swallowing also occurs sequentially while food that has not been fully masticated remains in the mouth [6]. For this reason, humans are able to efficiently form, divide and swallow boluses of food while masticating and tasting them, even when large amounts of food are placed in the mouth, and can thus ingest abundant nutrition within a short period. This complex feeding and swallowing function is essential for humans to be able to ingest nutrients of the quality and in the quantity necessary for an intellectually and physically active life [7].

The neural circuits for mastication, together with those for the regulation of breathing, walking, posture and blood circulation, exist within the lower brainstem. The rhythmic movement of the jaw and tongue is regulated by the lower brainstem, mainly as a mechanism of rhythm formation based on information generated during mastication from sensory receptors in the oral cavity and masseter muscles [5]. In addition, control is achieved

via regulatory mechanisms in areas of the upper brain, including the cerebral cortex, amygdala, basal ganglia, mid-brain reticular formation, hypothalamus and cerebellum, which are involved in arousal, higher mental activity, emotion, instinct, homeostasis, taste, motivation to eat, food discrimination, saliva secretion, elicitation of swallowing and movement [8]. Moreover, there are many integrative effects, including health maintenance by the stimulation of saliva secretion, promotion of digestion and appetite regulation by stimulation of digestive juices and hormonal secretion, elicitation of a sense of safety and euphoria via the secretion of pleasure-related substances in the brain by the jaw and oral cavity sensation during mastication, brain activation, and promotion of faciocranial growth and development [8]. In other words, mastication is not only directly involved in digestive function in the oral cavity, but also plays very important and broad-ranging roles in maintaining vital functions.

One important factor inhibiting masticatory function in elderly people is periodontal disease, and numerous reports in recent years have examined relationships between the sustained chronic inflammation in periodontal disease and pathologies such as dementia, diabetes, cardiovascular disease, cancer, premature birth and low birth weight [9]. Associations of periodontal disease with these conditions are supported by a large body of epidemiological data [10], but no causal relationships have been adequately established [11]. This review summarizes the findings on dementia [12–15], which numerous recent studies have reported to be associated with masticatory function in the elderly. This issue is presently a major problem in geriatric medical and care-giving settings, and we consider the prospects for future research into mastication.

2. Relationship between masticatory function and dementia in the elderly

According to results published by a study group of the Japanese Ministry of Health, Labor and Welfare, an estimated 4.62 million people with dementia lived in Japan in 2012. A further 4.0 million people had mild cognitive impairment (MCI), which has a high probability of developing into dementia [16]. Altogether, one in four people ≥ 65 years old in Japan has or is at risk of dementia [17]. The prevalence of dementia increases with age, so the number of individuals with dementia is expected to continue rising.

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