

Masticatory efficiency analysis in different sagittal malocclusions

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Mastication is the first step in the digestive process, during which the food entering the mouth is physically ground which increases the food's surface area, thereby allowing efficient contact with digestive enzymes later in the digestive process.

Mastication is a complex, non-random, process characterized by the comminution into smaller particles to facilitate digestion. Because smaller food particles provide a larger surface area for enzymatic function, both food breakdown² and gastric emptying³ are facilitated. Carlsson⁴ defines masticatory ability as an individual's own assessment of his or her masticatory function, whereas masticatory efficiency is defined as the capacity to reduce food during mastication. Special mastication tests define efficiency indexes and thus allow some quantitative assessments of this masticatory function. Masticatory efficiency can be measured by counting the number of chewing strokes required to reduce food to a certain particle size before swallowing, and masticatory performance is measured by assessing the particle size distribution of food when chewed for a given number of strokes⁵. The process of chewing, which typically ranges from 10 to 40 masticatory cycles allows food to be effectively reduced in size and moistened by saliva, thus forming a bolus, which can be easily swallowed⁶⁻⁸. Results from several studies regarding the relationship between masticatory efficiency and dietary intake are contradictory. It has been suggested that difficulty in eating tough and hard food in patients, with decreased masticatory efficiency, may lead to omission of such food from the diet and result in an increased risk of dietary deficiency.

However, some investigators found no relationship between masticatory efficiency and dietary intake. 12-16 Subjects with poor masticatory function have reported changes in the types of food they choose to eat, 17-19 with malnutrition as a possible consequence^{10, 20}. The association of poor masticatory performance with gastritis, gastric ulcers, and gastric carcinoma²¹⁻²⁴ suggests that the digestive process is directly affected. In a study of a hospital population, Mumma and Quinton²³ concluded that masticatory efficiency has some influence, though not statistically significant, on the occurrence of gastric distress. Greene et al²⁵ have shown that patients with insufficient masticatory ability have a significantly higher incidence of gastrointestinal complaints than persons with sufficient masticatory ability. In a later study by Boccardo and Betancor, ²⁶ gastric secretion was found to be related to masticatory ability. Masticatory efficiency is highly correlated to the quality of one's life, as it allows management of nutrition supply and health through food consumption. Thus, a decrease in masticatory efficiency can have a negative effect on the quality of life. ²⁷ Interest in studying masticatory function has been focused on assessing the efficiency or performance of mastication.

This was accomplished by testing the subject's ability to grind or pulverize food or a test material, the breakdown of food in the masticatory act is complex and includes biomechanical, enzymatic, and bacteriological processes. ²⁸ However, most effort has been concentrated on studying the mechanical breakdown of food. Various methods have been described in the literature for testing mechanical breakdown of food, ^{29, 30} which has been referred to by many terms, e. g. chewing efficiency, masticatory

performance, masticatory efficiency, chewing ability, masticatory function, and masticatory effectiveness. It was found that the amount of food in the mouth will affect the size of the particles to be swallowed, “ swallowing composition”. 31-33 The increase in the bolus size resulted in a decrease in the chewing strokes per standard portion of food, leading to swallowing of coarser particles of food. Swallowing composition was also correlated with the rate of food breakdown. 34 This is interpreted as showing that subjects with poor masticatory efficiency do not compensate for this by chewing more strokes but tend to swallow larger particles than subjects with good masticatory efficiency. 35 Techniques for measuring masticatory efficiency have been in use since 1924; one of the techniques is fractional sieving, which involves separating the food after chewing for a given period of time. 36 Most tests for masticatory efficiency or performance evaluate the particle size distribution of food stuffs after a given number of chewing cycles 5. A food comminution test with a sieving method has been typically used to test masticatory performance 37-40. However, it is said that the comminution test is too complicated to apply clinically and needs too much time for testing and evaluating. 41 One of the reasons for the use of the comminution test may be that the main function of mastication is to comminute food. Some foods need to be comminuted while others need to flow or form a bolus before swallowing.

The physical properties of foods should be considered before the study of masticatory performance is conducted 33. Various test foods have been used. They were either natural foods, like peanuts, almonds, ham, carrots, bread, coffee beans or squid 18, 42-45, modified natural products such as <https://assignbuster.com/masticatory-efficiency-analysis-in-different-sagittal-malocclusions/>

hardened gelatine or wine gums 46, 47 or artificial material, e. g. , silicone or chewing gum. 48-50 Historically peanuts were used for their predictable fracture performance. 18 With the sieving method the chewed specimen is spat out and rinsed through a stack of sieves with decreasing mesh apertures, where the particles are separated by their size. The individual particles on sieves are then dried and weighed to analyse the food comminution. Although considered the ' gold standard' chewing efficiency test, the sieving method is messy and time consuming 51. Subsequently, simple and hygienic methods for assessing the size of food particles by using computerized image processing software were introduced. 52 Sato et al. suggested an easier and simpler method involving the use of a hexahedral paraffin wax cube with alternate layers of two different colors. The patient is allowed to masticate for a given time, after which masticatory efficiency is assessed by analysing the chewed paraffin wax cube. The mixing ability index (MAI) is then calculated on the basis of the differences in the color mix and the area of the two differently colored wax cubes by using a computerized image analysis software. 41 Prinz developed a digital image processing technique to assess the degree of blending. 50 His image processing method produced quantitative data but the subjective assessment (SA) of a wafer by a trained examiner proved equally reliable.

However, his imaging approach is not widely applicable because the custom-made software is not commonly available. Color-mixing of the chewed test food can be assessed objectively by computer analysis of digital images⁴¹,⁵³ subjectively by visual inspection⁵⁴⁻⁵⁶ or by both. 8, 57 Masticatory ability can also be assessed subjectively by questionnaires or personal

interviews. 58-59 Some pieces of evidence demonstrate that the mixing ability test with the two-coloured chewing gum or wax is a valid and reliable alternative for food comminution tests 41, 60. Some investigators report that visual assessment of the chewed bolus has similar accuracy as computer assessment of digital image 50. Others show that visual assessment is less reliable than computer assessment, but it may still be useful in screening of chewing deficiencies in a clinical setting 61. Several factors are known to affect masticatory efficiency, for example, the occlusal contact area, 62-64 bite force, 65-67 malocclusion, 39, 40 number of functional teeth, 68 oral motor function, 69 and temporomandibular dysfunction. 70 The association between malocclusion and masticatory function is of clinical importance because there is no agreement on whether malocclusion is a physiological or a pathological condition 71-73 & orthodontic treatment is made to achieve correct occlusion in harmony with form and function. Several studies have reported the influence of surgical orthodontic treatments on masticatory performance 74, 75. Others have reported the negative effects of malocclusion on masticatory performance 39, 40, 76. Therefore, it is important to evaluate the quantification of masticatory performance in clinical orthodontics so that it becomes possible to determine how orthodontic treatments influence oral function.

Based on global indices of malocclusion, Omar et al⁷⁷ reported a moderate correlation between masticatory efficiency and the orthodontic treatment priority index; Akeel et al⁷⁸ showed a low correlation between masticatory efficiency and the orthodontic treatment need index. Manly and Hoffmeister⁷⁹ reported similar masticatory performance for children with Class I and Class

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II malocclusion; patients with end-on malocclusion performed less well.

Shiere and Manly⁷⁶ demonstrated similar levels of masticatory performance for children with normal occlusion, Class I malocclusion, or Class II malocclusion, all of whom performed better than children with Class III malocclusion. Henrikson et al.⁶³ showed that girls with normal occlusion had better masticatory performance than their Class II counterparts. Henrikson et al.⁶³ and English et al.⁴⁰ have reported that malocclusion negatively affects masticatory efficiency. Iwase et al.⁶⁸ also reported that the masticatory efficiency of a patient with mandibular protrusion increased when malocclusion was improved after an orthognathic surgery. It has been assumed that vertical facial morphology is an important mechanical factor influencing the masticatory muscles^{80, 81}.

Greater hyperdivergence is related to poorer mechanical characteristics⁸¹, indicating that subjects with reduced posterior facial height for a given anterior facial height (characteristics commonly found in dolichofacial subjects) present weaker masseter muscles⁸². It is reported that subjects with a long-face pattern show lower bite force,^{81, 83, 66} as well as lower electromyographic (EMG) activity of masticatory muscles.⁸⁴⁻⁸⁶ On the basis of their study on children and teenagers, Toro et al.³⁹ reported no difference in the masticatory efficiency of patients with Class II malocclusion and normal occlusion. Previous studies have compared different Angle classification of malocclusion but have not carefully controlled for the severity of the malocclusion within each Class. This has led to conflicting results when comparing masticatory performance among different malocclusion groups.^{76, 63, 40}

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