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Complete Denture Masticatory Efficiency: A Literature Review

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ABSTRACT The restoration of masticatory function and esthetics is an important aim in dentistry mainly when patients present with extensive tooth loss. The aim of mastication is to reduce food size to produce a homogeneous bolus appropriate to be swallowed. For edentulous patients, chewing efficiency is reduced because dental arches are replaced by artificial teeth. The aim of this study is to present factors related to chewing efficiency for the edentulous patient.

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The restoration of masticatory function and esthetics is an important aim in dentistry mainly when patients present with extensive tooth loss.[1]

Mastication is the first phase of the digestive process and it is considered an essential function of the stomatognathic system. Chewing breaks down food that will be swallowed and digested. The mechanical breakdown of food aids the enzymatic process that depends on food chewing.[2]

Chewing requires muscular coordination to perform mandibular movements and generate enough force to cut, crush, and grind food to keep it on the tooth occlusal surface. The activity of mandibular elevator muscles depends on food texture since they need to overcome food resistance during chewing.[2,3]

Chewing efficiency can be enhanced by the patient's capability of breaking down food evaluated by a system of sieves with different meshes. In edentulous patients, chewing efficiency is reduced due to replacement of dental arches by artificial teeth. Natural tooth loss causes alterations as bone resorption, temporomandibular disorders, and muscular hypotonicity that affect structures related to mastication and mandible stabilization.[4]

Literature Review

In 1954, Beyron stated that chewing should be performed usually by both sides since unilateral chewing could result in progressive occlusal disharmony as a result of abnormal wear.[5]

Sheppard et al. in 1968 evaluated usual mastication by cinefluorography to assess bolus placement during mastication. The authors observed that among 25 subjects with natural dentition, seven preferred only one side.[6]

Ten years later, Rissin et al. studied chewing efficiency in 29 patients.[7] They used the sieving method and the electric activity record of the masticatory muscles. The patients were divided into three groups. Group 1 was composed of 10 dentate patients; group 2 was represented by 10 complete dentures wearers; and group 3, represented nine patients with upper denture and lower overdenture. Results showed that electric activity of the masseter muscle during mastication was similar among the groups.

Haraldson et al. in 1979 evaluated oral function in complete denture wearers by using a questionnaire, clinical examination, and bite force tests.[8] Ten patients with satisfactory and 10 with unsatisfactory dentures were studied. According to the authors, edentulous persons are very handicapped in masticatory function, and even satisfactory complete dentures are poor substitutes for natural teeth.

In 1982, Gunne et al. studied the masticatory efficiency in 19 patients before and after new complete dentures insertion.[9] The test chewing material was gelatin hardened by formalin and later dehydrated. The chewing test and the sieve system were standardized. Results revealed no statistical significant differences among the periods evaluated in chewing efficiency tests. No significant difference was noticed between old and new dentures during the seven months of evaluation.

Gunne and Wall evaluated masticatory efficiency in 43 patients with adequate intraoral conditions and favorable jaw and mandibular ridge.[10] The subjects were tested on three occasions: with the old and the new complete dentures, at the moment of insertion, and four months after insertion. The old dentures were unstable and with occlusal disharmony. Gelatin was used as a material for the masticatory efficiency test. Masticatory efficiency of old dentures wearers increased significantly four months after the new dentures were inserted. This study showed a correlation between new dentures insertion and previous experience.

Lucas et al. concluded that food comminution during mastication reduced the particles' size and decreased the time of masticatory cycles.[11] The maximum opening amplitude of masticatory movement is more related to food volume than to particle size.

EDENTULOUS PERSONS are very handicapped in masticatory function, and even satisfactory complete dentures are poor substitutes for natural teeth.

In 1992, Slagter et al. studied the force-deformation of natural and artificial foods for masticatory efficiency test.[12] Two artificial foods (Optosil and Optocal) and two natural foods (peanuts and carrots) were evaluated and compared. The influence of cusp form on food comminution also was evaluated. The force of trituration was lower for Optocal than for Optosil artificial test food.

The forces needed for Optocal coincided with those needed for carrots and peanuts. The natural foods showed more variation in force and percentage of deformation than the artificial foods. The artificial foods, with different cusp inclination, were more resistant to trituration than natural foods.

According to Wilding, chewing efficiency can be defined as food breakdown with minimum effort and maximum particle size reduction.[4] The number of masticatory cycles or time dispended during chewing before swallowing can reflect masticatory efficiency. The authors affirm that chewing efficiency is related to dentition conditions as a number of posterior teeth, occlusal contact area, malocclusion degree, and the number of teeth.

Many factors may determine masticatory performance. According to Julien et al., occlusal contact areas represent available area for shearing food during each chewing cycle.[13] Patterns of mandibular movements determine speed and direction with which teeth surfaces come together during each masticatory cycle. Muscular strength reflects the available force to cut or crush the food according to a bite force record.

Karkazis and Kossioni studied the influence of food texture during the electric activity of the masseter muscle in a sample of nine satisfactory complete denture wearers.[14] Carrots and apples cut into equally sized pieces were used as hard and soft test foods. The activity was higher for hard than soft foods. The chewing rate and chewing cycle duration presented inverse correlation since the higher masticatory muscle strength, the lower the chewing cycle.

Gavião determined the correlation between volume and consistency of natural and artificial foods and physiological chewing parameters.[15] Masticatory efficiency was evaluated by the measurement of digitalized images from Optosil particles. Results showed that food volume influenced significantly saliva secretion, and the number of chewing cycles before swallowing.

In 2004, Peyron et al. evaluated the influence of age on masticatory capability regarding food hardness.[16] Age was associated to an increase of 0.3 cycles for each year and an increase of electric activity. Cycle duration and mouth opening was negatively influenced by age. The number of cycles to perform an adequate chewing increases with age and the greater hardness of food.

Honma et al. assessed chewing efficiency among 116 patients with normal occlusal relationships.[17] The number of chewing cycles up to the point of the first swallowing for both free-sided chewing and unilateral chewing; saliva secretion; occlusal force; and contact points were measured for each patient. According to the averages of the three parameters, the patients were classified into two groups (high and low scores). There were patients with unilateral and bilateral biting at both groups. The amount of remaining coarse particles immediately prior to the first swallowing was evaluated at both groups. The patients of free-sided chewing presented fewer numbers of chewing cycles on three parameters at both groups. The amount of remaining coarse particles by free-sided chewing was significantly smaller than that of unilateral chewing on three parameters and at both groups.

Discussion

In some patients, the reduction of electric activity of masseter muscle during chewing with new dentures may result from a new occlusal condition.[5,18] The new prosthesis with adequate cusps position makes easy intercuspation and requires less strength to food comminution.[3,9,19-21] The reduction of strength activates proprioceptors in alveolar mucosa and muscular tendons that cause new patterns of force control during prosthetic intercuspation.[22]

According to the studies, new dentures wearers with occlusal equilibrium present an increase in chewing efficiency, even in a short period and without muscular adaptation.[2,9,10,12,19,20,23]

However, old denture wearers may present large particles of food after chewing as an increase and decrease in electric activity of temporal and masseter muscles, respectively. This fact may be associated to an absence of physical conditioning and muscular ability that results in inappropriate occlusal adjustment with premature contacts which destabilize and hamper mastication.[24-26]

NEW DENTURES WEARERS with occlusal equilibrium present an increase in chewing efficiency, even in a short period and without muscular adaptation.[2,9,10,12,19,20,23]

Many authors pointed to a decrease in the average of chewing cycles duration during chewing efficiency test after prostheses insertion.[4,13,17,27,28] This reduction resulted from a better occlusal equilibrium. The decrease in number of cycles occurs at the end of chewing were observed by Karkazis and Kossioni in 1998, Shikano in 1990, and Bradley in 1981 who reported a decrease of cycles during chewing due to a better food comminution.[7,11,14,16,17,29-32,34,35]

Kawazoe et al. concluded that, after a period of continuous chewing, the speed of muscle contraction decreases while its electric activity increases.[36] The patients present a greater bite force to masticate artificial foods due to the absence of cusps on the old denture.

Regarding efficiency and number of chewing cycles, most of the patients presented positive results with new prostheses due to occlusal equilibrium restoration and presence of artificial teeth cusps.

Furthermore, it is important that unsatisfactory denture wearers replace their prostheses every five years since muscular conditions, chewing efficiency, and temporomandibular articulation improve after occlusal restoration and better functional ability.

Conclusion

According to this review, the dental professional should know that a long period of complete denture wear may lead to denture instability due to a jaw's incorrect position, muscular and articular alterations, and chewing inefficiency.

Furthermore, progressive wear of artificial teeth causes reduction of occlusal vertical dimension and incorrect condylar placement that may cause difficult chewing. Dentists should guide patients regarding the use and replacement of complete dentures to improve oral health and chewing efficiency. ■■■■

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