Electromyographic Evaluation of the Influence of Denture Adhesive on Retention and Stability of Complete Denture

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By

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INTRODUCTION

Edentulism is a great problem in the dental field that the clinician could face in practice, however some edentulous patients despite of loosing their teeth, may still have adequate supporting bone which could support a properly constructed complete denture. The problem becomes magnified for the patients who suffer from excessive bone resorption. In this case, helping such patients in gaining their masticatory function constitutes a challenge for the clinician.

One of the factors that influence patients' responses regarding their success with complete dentures is the quality of retention.[1]. Several approaches to improve complete denture retention have been advocated. A simple conventional approach is the use of denture adhesives.[2]

Subjective and objective studies provide controversial results on the effects of denture adhesives on the masticatory ability. While results of some studies indicated that chewing efficiency improves significantly, some objective results found them to be ineffective and chewing ability depended on factors other than retention [3].

The present study was thus conducted to evaluate the effect of denture adhesives on denture retention, as well as, on the activity of masticatory muscles in complete denture wearers. The questions that the study was aimed to answer were whether the application of denture adhesives will in fact increase denture retention and muscular activity or not? and whether the type (form) of denture adhesive plays an influential role on these two factors or not ?

Retention of complete denture

Definition:

Retention was simply defined as the resistance of the denture to dislodgement in an occlusal direction.[4] It is the means by which dentures are held in position in the mouth resisting the forces of gravity, adhesiveness of food and the forces associated with opening the jaws.[1] **The Academy of Prosthodontic Terms (2005)** defined retention as the quality inherent in the prosthesis acting to resist the forces of dislodgement along the path of placement.[5]

Factors affecting denture retention:

Several factors affect denture retention. There are anatomical, physiological, physical, mechanical, surgical and psychological factors.

1-Anatomical factors:

They include arch shape and size, arch relationship, interarch distance, ridge and vault form, tongue size and position, quality of denture bearing area, amount of tissue coverage, shape and contour of the polished surface orofacial musculature and the neutral zone, as well as, neuromuscular control.[2]

The successful muscular control of dentures depended on two factors; the ability of the patient to acquire the necessary skill and the design of the denture.[7]
It was pointed out that the polished surface of a complete denture should possess certain contours to maximize the retentive potential of the functioning orofacial musculature. At the same time the contour and design of the polished surface should harmonize with the function of the tongue, lips, and cheeks to effect seating of the denture.[7]

Oral & facial musculature supply supplementary retentive forces, provided that the occlusal plane is at the correct level, the teeth are positioned in the neutral zone, the denture base is properly extended to cover the maximum area possible (without interfering with the health and function of the structures that surround the denture) and that the polished surface of the denture is properly shaped.[8]

The tongue is the most important and complex organ of the orofacial complex. The tongue may assume many shapes, and coupled with its musculature, the tongue has a wide and varied range of motion.[9]

Tongue positions were classified by **Wright** into three classes. **Class I**; the tongue lies in the floor of the mouth with the tip forward and slightly below the incisal edges of the mandibular anterior teeth, while in **Class II**; the tongue is flattened and broadened but the tip is in a normal position and **Class III**; the tongue is retracted and depressed into the floor of the mouth with the tip curved upwards, downwards or assimilated to the body of the tongue. Class II position has the most favorable prognosis as the floor of the mouth will be high enough to cover the lingual flange of the denture producing a border seal. [10]

A mandibular complete denture is considered stable if it can be maintained on its basal seat during normal function by the simultaneous integrated function of the tongue, lips, cheeks and occlusion. In addition it is estimated that tongue size increases by approximately 10% in the edentulous patients. To achieve better stability for the lower denture, the tongue size must be considered in relation to the space in which it moves. Large tongue is considered to be a factor in good border seal, contrary to a small tongue [10] which may not be able to physically press

against the posterior part of the maxillary denture thus reducing the retention significantly.[11]

The Neutral zone is defined as the potential space between the lips and cheeks on one side and tongue on the other side. Natural or artificial teeth are subjected to equal and opposite forces in this zone from the surrounding musculature.[12] It is also referred to as the dead space, the stable zone and the zone of conflict. The function of the lips, cheeks and tongue and their controlling action on the dentures during function is a fundamental principle behind the neutral zone concept.[13] **Watt**[14], stressed on the importance of reproducing the ridge and contiguous tissues in their anatomic and functional form to be able to set the artificial teeth in the approximate position that was previously occupied by the natural teeth. Various methods have been tried for the reproduction of the vestibular and lingual configuration of the neutral zone so that the tissues at rest and in function will aid rather than interfere with the retention of the denture.[15, 16]
The neutral zone also defines the external contour of a denture base, in order to work in harmony with adjacent supporting and stabilizing muscle actions, thus giving the prosthesis more natural feel to the patient, improve mastication, provide comfort and patient satisfaction.[13] Violation of the neutral zone may cause denture movement during speech, chewing or swallowing.

2-Physiological Factors:

The relationship between a denture and the underlying tissue is dynamic. Whenever the denture moves relative to the tissue, the viscosity of the interposed saliva film resists or dampens this movement and also provides a retentive force[17]. It has also been reported that when there is close adaptation between the denture

and the mucosa, a thin film of saliva tends to flow and increase its surface contact thereby increasing the retention. [1, 18]

3- Physical Factors:

Physical factors that may affect complete denture retention include adhesion , cohesion, interfacial surface tension , atmospheric pressure, gravity and capillary attraction.

Several factors may have a direct influence on these physical forces. Consistency of saliva may affect adhesion, cohesion and surface tension. Also atmospheric pressure could be affected by good peripheral seal, perfect fit of the denture and maximum coverage of the basal seat. Good adaptation of the denture base to soft tissue, greater surface area of the denture-bearing area and thin film of saliva are all factors that improve capillary attraction .[2]

The factors affecting denture retention have been classified as a combination of muscular factors that are exerted by cheeks, tongue and lips upon the polished surface of the denture **and** physical factors that act between the supporting tissues, the denture base and the interposed saliva film. The retention of dentures was considered to be mainly due to the physical forces and therefore the surface tension makes an increased contribution to denture retention. [17]

It has been concluded that when a thin film of saliva was interposed between the denture and the mucosa it acted as a fluid medium and established the physical forces of retention which are adhesion, cohesion, surface tension, atmospheric pressure and gravity. [19]

De Majistris summarized the factors involved in denture retention as : negative pressure under the denture, capillary adhesion and cohesion, interfacial surface tension , viscosity of saliva and surface roughness of the denture base. Emphasis was placed on the importance of adhesive forces and the role of fixatives. However the point was made that the exact role of adhesion and cohesion was unclear. [20]

Some investigators stated that retention is too often given more consideration than is necessary. It should be readily seen that if the other objectives (atmospheric pressure, adhesion, cohesion, and mechanical locks) are achieved, retention will be adequate. [21]

Other investigators believe that retention is dependent on a complex interplay of factors including the surface area of contact between the denture and the supporting tissues, the adaptation of denture base, surface tension factors, peripheral seal, and neuromuscular control. These factors vary within and between patients and cannot be quantified. Clinically, base tissue contact, base extension and border seal are the factors that may be influenced by the clinician. [22]

4-Mechanical Factors:

There are several mechanical factors that may influence complete denture retention. They include undercuts, magnetic forces, suction chambers and suction discs, balanced occlusion and springs.

Suction cups and chambers cause inflammatory tissue reactions and therefore no longer recommended. [23]

It is believed that a balanced functional occlusion is critical in promoting denture retention. Regardless of the chosen occlusal scheme, the occlusion must be free of interferences within the functional range of movement of the patient to avoid any dislodging forces. [24]

It is a prerequisite, for stability and retention in all complete dentures that posterior occlusal contacts occur simultaneously and bilaterally; furthermore these contacts should occur in centric relation and at the appropriate occlusal vertical dimension. In some patients (those with a ruminatory chewing pattern) it will also be necessary to harmonize the dynamic occlusion in order to ensure denture stability and retention. [25]

5-Preprosthetic Surgical factors:

Common conditions that require surgical correction prior the construction of complete dentures to improve the retention are the removal of soft tissue abnormalities, hypermobile ridge tissue, hypertrophic maxillary labial frenum , prominent buccal frenum, osseous abnormalities, and ridge undercuts. [10]

Most preprosthetic surgical procedures of value are directed towards enabling the construction of a retentive denture base. This is obtained by utilizing the physical forces of retention , and these are developed by extending the base until its border lies on displaceable tissue to provide a seal and ensuring that the base has close contact with the underlying tissues.[25]

The use of dental implants is recommended by many investigators for enhancing complete denture retention.[26] Retention is achieved either by friction