

Rationale for denture valves in complete denture retention

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Complete dentures are the most common prescription offered to edentulous patients worldwide. It is estimated that 1 in 3 adults are edentulous. In the United States alone, the number of adults requiring complete dentures is expected to increase from 33.6 million in 1991 to 37.9 million in 2020 (1). Over the next two decades, according to current predictions, the declining incidence of edentulism (2-3) will be more than compensated by 79% increase in adults over 55 years of age (1). It has been estimated that the 56.5 million dentures made in the United States in 2000 will increase to more than 61 million dentures in 2020 (1). The two major reasons why patients seek denture therapy are to improve aesthetics and to improve mastication (4-5). Around one quarter of patients are likely to be dissatisfied with their dentures (5-6-7). The high failure rate of complete dentures might be one of the reasons why practitioners often prefer to refer these patients for treatment elsewhere. Whilst alternatives, such as implants, can be offered, these might not be suitable for all patients, because of fear, or financial constraints among others (8).

Denture Valves may provide an affordable option of choice to those patients that are not suitable candidates for implants, or cannot tolerate the limitations of denture adhesives.

The objective of this article is to demonstrate the rationale for denture valves in complete denture retention:

- 1) Short term lower pressure, generated by external means beneath the dentures, tends to hold them in close proximity to the tissues, thus maintaining a seal at the borders.
- 2) The role that denture valves may play in the context of patient adjustment and acceptance of the dentures.

Denture retention is by definition, resistance of a denture to vertical movement in the opposite direction, away from the tissues (9).

Psychological acceptance, adhesion, cohesion, viscosity, gravity, oral and facial musculature, vacuum and atmospheric pressure have all been mentioned at one time or another, as major or minor contributory factors. There has been published detailed analysis of the underlying principles of denture design and the contributory factors in complete denture retention.

The understanding exists and there is general acceptance among clinicians that denture retention is dependent on the control of the flow of interposed fluid, its viscosity and film thickness. Interfacial surface tension contributes to retention, but the most important are good base adaptation (10-11) and border seal (8-12-13). However at the first displacement, which is inevitable at some point, a gap opens along the border seal, consequently reducing the resistance to vertical movement and subsequently lifting up the denture.

In practice, complete denture retention remains a perplexing subject. The failure rate remains high. Its logical solution exists but is often obscured by erroneous beliefs.

Complete denture retention is in fact a dynamic issue. First there is a need to achieve an accurate fit of the denture to the tissues, so that the space between the two is as small as possible. Secondly, there needs to be a border seal. Thirdly, there is a need for a pulling force in the direction of the path of insertion to resist the dislodging forces. Other factors may only contribute to retention if the fundamental principles were achieved in full.

Psychological Acceptance

It is important that patients perceive their dentures as stable during function and their aesthetic appearance meet the psychodynamics required by the patient (4).

Wearing dentures for the first time can be as hard as learning how to swim.

Developing wrong habits in the early stages of denture wearing are the major reasons for malnutrition, resulting from not being able to chew and swallow properly (4-14).

Furthermore, there is nothing to stimulate the desire to eat and socialise when dentures are unstable.

Adhesion (12-15)

Adhesion has been claimed to be instrumental to denture retention. There have been numerous theories to prove that adhesion of saliva to the mucous membrane and the denture base is achieved through ionic forces between charged salivary glycoprotein and surface epithelium or acrylic resin. There has been no known ability to identify a specific mechanism for a direct acrylic-mucosa reaction that would achieve this. The concept of physical attraction of unlike molecules for each other is unimaginable in the denture field.

Cohesion (16-17)

Physical attraction of like molecules for each other creates retentive force and usually occurs with saliva that is present between the denture base and the mucosa. Normal saliva is not very cohesive, and unless the interposed saliva is modified with the use of denture adhesive, retentive force cannot be achieved.

Viscosity

This is the rate of separation of two surfaces under an applied force, best described in the context of surface tension and interfacial viscous tension. The force holding two wet glass planes together against a straight pull, or the force holding two parallel plates together are due to the viscosity of interposed liquid.

Stefan's law (24) describes that the viscous force increases proportionally to increases in the viscosity of the interposed fluid. When the equation is applied to denture retention, it demonstrates the need for a good base adaptation to the tissues and the importance of taking full advantage of the surface area covered by the denture. This may be relevant to the maxillary denture. However, if the two plates with interposed fluid are immersed in the same fluid, there will be no resistance to pulling them apart. Since the borders of the mandibular denture are bathed in saliva, surface tension, viscosity and film thickness may not play a role in lower denture retention (17).

Gravity

The weight of a lower prosthesis constitutes a negligible gravitational force and is insignificant in comparison with the other forces acting on a denture. Anecdotal or trivial as it may seem, evidence suggests that this may be beneficial in cases where other retentive forces and factors are marginal (18-19).

Oral and facial musculature.

Muscular control is an important aspect of successful complete denture therapy (20-21). Although this may supply additional retentive forces, provided that the polished surfaces are properly shaped, the teeth are positioned in the neutral zone and the denture bases are properly extended to cover the maximum area possible, retention is a quality of the denture rather than that of the patient. Therefore, musculature is relevant only in the context of 'manipulative skill' of the patient, rather than in retention in the strictest sense.

Atmospheric pressure - Vacuum

Atmospheric pressure has been claimed to be an important factor in complete denture retention (22-23). For atmospheric pressure to be effective, it must operate under condition of a pressure difference - (de) pressure. There must be a lower pressure beneath the dentures and only if vacuum were there the full effect could be felt.

Atmospheric pressure can act to resist dislodging forces, if the dentures have an effective seal around their borders (16-26). This is called 'suction' because it is the resistance to removal in a direction opposite to that of insertion. But there is no suction or negative pressure, except when another force is applied (17).

Under the assumption that vacuum could be generated by exerting a pull that tended to increase the volume beneath the base of the denture and the tissue, the lower pressure would have to be generated by external means and a perfect seal created and maintained around their entire borders for the lower pressure to be sustained.

This can be achieved by taking full advantage of the mechanism principle of denture valves.

The benefits to patients in terms of function, successful outcome of denture retention and quality of life that denture valves may offer, outweigh by far the possible side effects-tissue reaction (25), namely soft tissue proliferation which under proper management can be kept to a minimum.

The philosophy of 'best practice' should include denture valves as an option in complete denture therapy, especially for those patients that are willing to make informed and consensual decisions- but that is another issue altogether.

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