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Atmospheric Pressure As An Emergency Retentive Force In Complete Denture Retention: A Review

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Abstract
Retention of complete denture depends on many factors; one among them is atmospheric pressure. Role of atmospheric pressure as an emergency retentive force in the retention of denture base to mucoperiosteum is critical as long as dislodging forces act on denture. The purpose of this article is to understand the role of atmospheric pressure as a physical force in the retention of complete denture in the light of literature and the current understanding of physics.

Key Words
Atmospheric pressure, Peripheral seal, Retention, Vacuum

Introduction

Retention is the inherent quality of prosthesis which resists its removal along its path of insertion. The force of gravity, adhesiveness of foods, and forces associated with opening of jaws tend to remove the prosthesis and effect retention. The forces that keep the denture in place and are involved in denture retention are adhesion, cohesion, interfacial surface tension, peripheral seal and atmospheric pressure. Atmospheric pressure can act to resist dislodging forces applied to dentures, if the dentures have an effective seal around their borders.

Review of Literature

Stanitz stated that there is a difference in pressure between the atmosphere and fluid film[1]. Landa stated that the atmospheric pressure aids in retention of dentures[2]. Oehl and Dreson acknowledged that atmospheric pressure acts only if peripheral seal is correctly formed[1]. Snyder showed that reduced atmospheric pressure decreases denture retention with the help of a decompression chamber[1]. According to Skinner et al. atmospheric pressure is an ordinary suction and vacuum chamber does not have much influence on retention[3]. Page and Moss considered atmospheric pressure to be of minimal importance in retention. According to them interfacial surface tension helps in retention[1].

Definition

Atmospheric pressure is defined as the force per unit area exerted against a surface by the weight of the air above that surface. Thinking in terms of air molecules, if the number of air molecules above a surface increases, there will be more molecules to exert a force on that surface and consequently, the pressure increases. The weight of the air molecules above one square inch on average weighs 14.7 pounds at sea level; this means pressure applied by the air molecules would be 14.7 pounds per square inch.

Fig 1 : Pressure On A Suction Cup As Exerted By Collisions Of Gas Molecules That Holds The Suction Cup In Contact With The Surface.

Applied Physics

The denture is attached to mucoperiosteum in the same manner as a suction cup is attached to a windshield of a car, through the force of atmospheric pressure. The working face of the suction cup has a curved surface. When the center of the suction cup is pressed against a flat, non-porous surface, the volume of the space between the suction cup and the flat surface is reduced, which causes the air between the cup and the surface to be expelled past the rim of the circular cup. Once the air is forced out, a partial vacuum is formed. Since atmospheric pressure will always try to equalize itself, air naturally tries to fill in any missing gaps **(Fig 1)**. This pressure pushes against the air outside of the suction cup. Since it cannot penetrate the suction cup surface, it forces it instead against the flat piece of glass. If air can pass under the edges of the suction cup, or through the surface, the "seal" will break and the suction cup will fall off.

A denture cannot be distorted like a suction cup, but oral mucosa can be. When a force is exerted perpendicular to and away from the basal seat of a properly extended and fully seated denture; pressure between the prosthesis and the basal tissues drops below the ambient pressure, resisting displacement. Retention due to atmospheric pressure is directly proportionate to the area covered

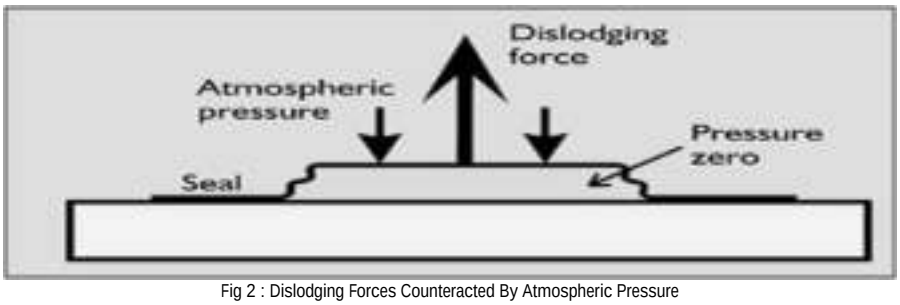

Fig 2 : Dislodging Forces Counteracted By Atmospheric Pressure

by the denture base. For atmospheric pressure to be effective, the denture must have a perfect seal around its entire border. Proper border molding with physiological, selective pressure techniques is essential for taking advantage of this retentive mechanism[4].

Discussion

Denture retention will be a subject perplexing and perpetual until its troubles find their logical solution in understanding its physics[5]. Retention is the inherent quality of prosthesis which resists the force of gravity, adhesiveness of foods, and forces associated with opening of jaws[6]. Peripheral seal and intimate tissue contact are basics for retention of complete denture. The peripheral seal prevents air entry between the denture surface and the soft tissues. To achieve good peripheral seal, the denture borders should rest on soft and resilient tissues. Such tissues allow the movement of mucosa along with the denture base during function thus constantly maintaining peripheral seal. A partial vacuum could be generated by virtue of displacing forces that tends to increase the volume between the denture base and the soft tissue beneath; the requirement would be for a seal to maintain some area of the lowered pressure. If peripheral seal is maintained, increase in volume between the denture base and mucoperiosteum results in lesser number of air molecules in the confined space. The partial pressure inside the confined space will decrease and atmospheric pressure outside the denture will try to equalize the pressure difference thus pressing the denture base towards the mucoperiosteum. This property is called natural suction of a denture[7]. Suction or negative pressure develops only when another force is applied on the denture base away from the basal seat; suction alone applied to the soft tissues of the oral cavity for even a short time would cause serious damage to the health of soft tissues under negative pressure. Tissue hyperplasia can result as a consequence to negative pressure.

Thus atmospheric pressure could only operate by way of a pressure difference, that is, beneath the denture there must be a lower pressure, and the full effect could only be felt if there were a vacuum there. The 'retention' thus generated is an emergent property, arising only because of the pull of the displacing forces and consequent displacement[7],[8] **(Fig 2)**. Thus atmospheric pressure is called emergency retentive force or temporary restraining force (14.7lb/sq. Inch). This means that the retentive force supplied by the atmospheric pressure is directly proportional to the area covered by the denture base.

Factors that have enhancing effect of atmospheric pressure[1]

1. Good peripheral seal
2. Perfect fit of denture
3. Maximum coverage of basal seat
4. Balanced occlusion
5. Shape of polished surface

Atmospheric pressure and Surface Tension

Under normal conditions, there is no pressure difference, no static retaining force, and atmospheric pressure as such has no bearing on retention[9].

1. In function, atmospheric pressure is superior to other retentive means such as surface tension. Atmospheric pressure resists forces that are horizontal as well as parallel to the mean mucosal plane
2. Interfacial surface tension will resist only forces perpendicular to the axes of surface tension forces.

Limitations

In spite of its superiority to counteract dislodging forces, use of atmospheric pressure to secure attachment is not recommended[10], reasons being:

1. Attachment through atmospheric pressure is usually transient, air chambers and rarified air spaces tend to fill in with tissue and saliva.
2. May not be physiological to alveolar bone[11].

Conclusion

At rest the pressure of the atmosphere has commonly been claimed to be an aspect of complete denture retention, but this is readily shown to be false.

Atmospheric pressure is an important factor in complete denture retention as long as dislodging forces act on the denture i.e. during function, provided proper peripheral seal is maintained.

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