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AN IN –VITRO COMPARATIVE STUDY OF WETTABLITY OF TWO COMMERCIALLY AVAILABLE SALIVA SUBSTITUTES AND DISTILLED WATER ON HEAT – POLYMERISED ACRYLIC RESIN

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Abstract

Background: Denture retention remains as complex issue influenced by multiple physical factors. Adequate retention is essential for successful complete dentures, relying on mechanisms such as adhesion, cohesion, surface tension, and wettability. Wettability, defined as the ability of a liquid to spread over a solid surface, plays a key role in enhancing denture retention. Improved wetting reduces interfacial energy and strengthens adhesion between saliva and the denture base.
Aim: To compare the wettability of two commercially available saliva substitutes and distilled water on heat-polymerized acrylic resin.
Materials and Methods: 120 heat-cured acrylic resin samples of 2 mm thickness were prepared. Tissue surfaces were left unpolished, while the opposite surfaces were finished and cleaned. Samples were divided into three groups: wet mouth, distilled water and E-saliva. Contact angles were measured using a goniometer and analyzed statistically.
Results: Results showed that E-saliva exhibited the lowest contact angle, indicating superior wettability, followed by wet mouth and distilled water. Thus, E-saliva demonstrated the best potential for improving denture retention.
Conclusion: Within the limitations of the present study the following conclusion can be drawn. Among the three groups the advancing and receding contact angles for group the group 3 (E saliva) is lesser than group 1(wet mouth) which is less than group 2(distilled water). Therefore the wettability of E saliva is greater than wet mouth which is greater than distilled water.

Introduction

Adequate retention is a basic requirement for the acceptance of complete dentures and physical mechanisms of denture retention are of great importance. A sufficient layer of mucous saliva is essential for retention.[1]

Many physical forces and factors have been credited with causing or enhancing retention, e.g. atmospheric pressure, vacuum, adhesion, cohesion, wettability, surface roughness, gravity, surface tension, viscosity, base adaptation, border seal and muscular control.[2,3]

Wettability refers to the lowering of the energy of a system when a liquid wets a solid surface. Thus, to break such an interface is similar to breaking the adhesion between solids work needs to be done to create the break and a strength can be attributed to it as an interface.[4]

It is true that if there is no wetting, no force would be needed to be applied to separate the denture from saliva and there would be no retention. Acrylic does, however, wets with water. With saliva, the effect is even

better proteins and Muco-polysaccharides from the saliva adsorb to the acrylic rapidly and strongly and in doing so present a surface which is more wettable.[5,6]

The contact angle of the saliva substitute on the denture base can be taken as an indicator of the wettability, the smaller the contact angle, the greater the wettability, or the contact angle is a useful inverse measure of wettability.[7]

Saliva plays a vital protective and functional role in the oral cavity, aiding lubrication, digestion, antimicrobial defense, and tissue maintenance. Reduced salivary flow (xerostomia) can impair these functions and compromise denture retention.[8,9]It may result from systemic diseases or treatments such as radiation therapy.Saliva substitutes, including carboxymethylcellulose- and mucin-based types, are used to manage xerostomia.[10,11]

Saliva substitutes containing components such as carboxymethylcellulose or glycerin are known to improve spreading ability and surface interaction with acrylic resin.[12,13] In contrast, distilled water exhibited the highest contact angle, reflecting comparatively poor wettability, likely due to its higher surface tension and lack of lubricating constituents.[14,15]

Improved wettability can enhance denture retention, particularly in xerostomic patients where natural saliva is insufficient. Therefore, saliva substitutes with better wetting properties may offer clinical advantages by improving comfort, reducing friction, and aiding in mastication and speech.

Materials and Methodology

One hundred and twenty samples of heat-cured acrylic resin were made by the following **method:-**

Two sheets of modeling wax of 1.5 mm thickness were placed one over the other to get total thickness of 3 mm to compensate for the loss of acrylic during the finishing procedure and to obtain uniform thickness of 2 mm in the acrylic samples.

Two rectangular glass plates measuring 2 × 2 cm were stabilized on either side of the wax strips and the wax was cut along all the sides using a sharp carver. The resultant wax sample was checked for required thickness and uniformity using wax Gauge. These samples were stored in air-tight containers.

Fabrication of heat-cured acrylic resin samples:-

The wax samples were invested using dental plaster in varsity flasks. A heat-activated conventional acrylic denture base resin material (ACRALYN-H, Asian acrylates) was used for Acrylization.

Flasking and processing was done according to the manufacturer's instructions. One hundred and twenty samples were made by the above method. The samples were stored in water for 24h.

The samples were finished to get an even thickness of 2 mm using flat cherry stones and sandpaper as in clinical practice. No finishing was done for surface to be tested (tissue surface).To get a flat surface, the samples were finished on the other side (polished surface) manually using sandpaper on a flat surface.

The samples were first cleaned for 5 min with soft cotton immersed in water saturated with household soap and then

rinsed well with running water. They were cleaned with spirit to remove any soap residues.

This was followed by immersion in sonic denture cleaner for 15 min. The samples were dried prior to viewing under an electron microscope.

The samples were then viewed under scanning electron microscopy to verify the effectiveness of finishing and cleaning procedures. The magnification used was at 2000×.

Preparation of the samples:-

After the cleaning procedure, the samples were placed in a glass petridish and placed in the oven. Then, the samples were dried in the oven at 44°C for 30 min and then cooled to a temperature of 22°C.The temperature of the room was controlled by air conditioners.

Measurement of contact angles:-

The advancing and receding contact angles were measured using contact angle goniometer and software (Digi drop version.13.06.2.) The 120 samples were divided into three groups with 40 samples in each group. Wet mouth was used in group 1; Distilled water in group 2; E saliva in group 3.

A pre-cleaned, oven-dried glass syringe was filled with distilled water up to 5 ml.

The syringe was carefully fitted into the metal housing and loaded on the syringe holder.

The metal housing had a knob on its superior aspect which could be turned clockwise in order to expel liquid through the needle. It was graduated in microliters; therefore, the liquid used for each drop could be standardized.

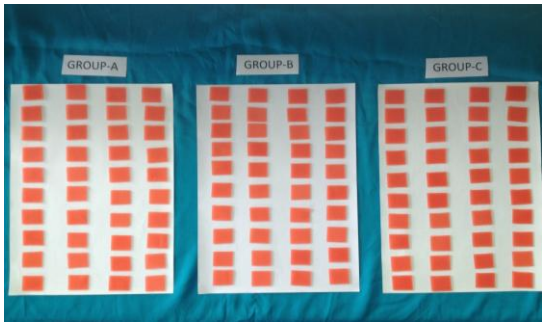
The acrylic sample was held with tweezers only on the sides, taking care not to touch the surface of the sample. The sample was placed at the centre of the table just below the needle of the syringe.

The software program Digi drop version 13.06.2.was used to measure the advancing and receding contact angles. After measuring the advancing contact angles, the drop was wiped away and a new area on the sample was selected for measurement of receding contact angles. The samples were placed at 24° inclined to the horizontal plane.

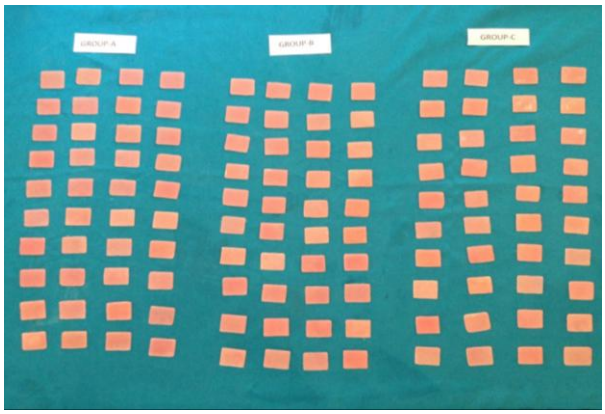
After the values were obtained, the sample was removed and a new sample was placed. The procedure was repeated for 40 samples in the first group.

Later, the above procedure was followed for all the samples in the three groups, and measurements were made and recorded.

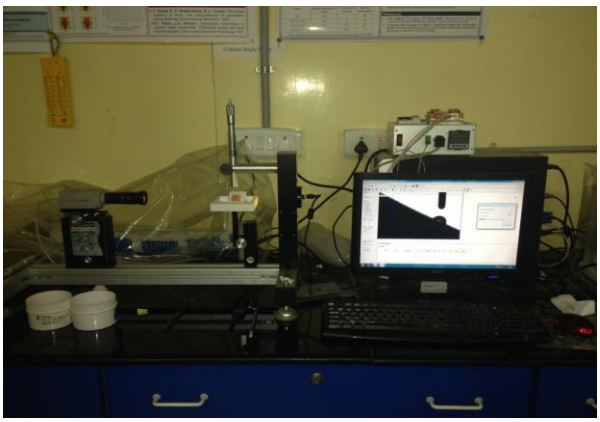
Materials used



Wax pattern samples



Cured acrylic samples



Contact angle Goniometer

Results

The contact angles were evaluated using contact angle goniometer and the statistical values were analyzed using ANOVA and TUCKEYS multiple comparison test.

ANOVA ANALYSIS OF THE ADVANCING AND RECEDING CONTACT ANGLES.

		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
AA	Between Groups	11429.157	2	5714.579	67.995	0.000
	Within Groups	9833.173	117	84.044		
	Total	21262.330	119			
RA	Between Groups	11436.469	2	5718.234	69.592	0.000
	Within Groups	9613.595	117	82.167		
	Total	21050.063	119			
DIFFE	Between Groups	119.143	2	59.572	1.974	0.144
	Within Groups	3531.457	117	30.183		
	Total	3650.600	119			

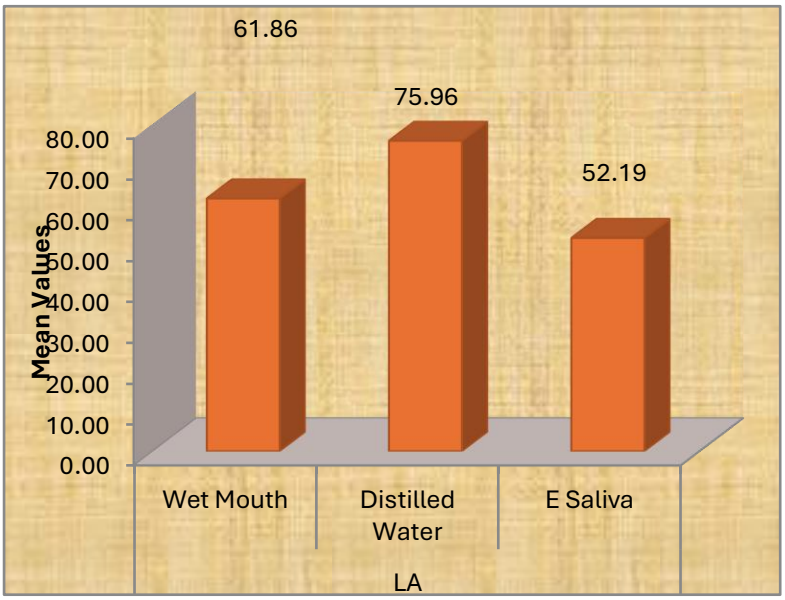
In the above table ANOVA test is used to evaluate the mean values of advancing and receding contact angles between and within the groups. The F and P values for receding contact angles are 67.995 and 0.000 respectively. The F and P values for advancing contact angles are 69.592 and 0.000 respectively. Since significant F and P values are observed for both the contact angles we can infer that there is difference in between the groups.

TUCKEYS MULTIPLE COMPARISION TEST OF THE ARTIFICIAL SALIVARY SUBSTITUTES AND DISTILLED WATER

sl.no	GROUPS	AA		RA		DIFF	
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
1	Wet Mouth	61.85b	7.97	66.16b	8.11	4.30a	5.96
2	Distilled Water	75.96c	10.31	78.22c	8.91	2.26a	4.12
3	E Saliva	52.19a	9.07	54.31a	10.07	2.12a	6.16
	p value	0.00		0.00		0.14	

In the above table TUCKEYS MULTIPLE COMPARISION TEST is done to compare the means of the contact angles of all the three groups. The P value for the groups is 0.00, which is significant.

BAR DIAGRAM SHOWING COMPARISON OF THREE DIFFERENT ARTIFICIAL SALIVA



Discussion

The present in vitro study evaluated the wettability of two commercially available saliva substitutes and distilled water on heat-polymerized acrylic resin using contact angle measurements. Wettability is a critical factor influencing denture retention, as improved spreading of saliva over the denture base enhances adhesion

and surface contact, thereby contributing to stability and comfort.[1]

The findings demonstrated that E-saliva exhibited the lowest contact angle, indicating superior wettability compared to Wet Mouth and distilled water. Lower contact angle values correspond to better spreading ability, which enhances the formation of a thin salivary film between the denture base and mucosa.[6,7]This improved film thickness increases capillary attraction and adhesive forces, ultimately aiding in denture retention.

The superior performance of E-saliva may be attributed to its composition, which likely includes viscosity-enhancing agents and mucin-like components that mimic natural saliva.[10,11]These constituents improve surface interaction with acrylic resin, reducing interfacial tension. In contrast, distilled water, lacking organic components and viscosity, showed the highest contact angle and poorest wettability, making it less effective in promoting retention.

The results are consistent with previous studies that have reported enhanced wettability of saliva substitutes over distilled water due to their physicochemical properties. Additionally, unpolished tissue surfaces used in this study may have contributed to improved wettability by increasing surface energy and promoting liquid spread.

However, this study has certain limitations. Being an in vitro investigation, it does not fully replicate intraoral conditions such as temperature variations, salivary flow, and mucosal dynamics. Further in vivo studies are recommended to validate these findings and assess long-term clinical effectiveness.

Overall, the study highlights the importance of selecting appropriate saliva substitutes, particularly for xerostomic patients, to improve denture retention and patient comfort.

Conclusion

Improved wettability enhances the spreading of the fluid over the denture base, which may contribute to better denture retention and comfort. Therefore, saliva substitutes, particularly E-saliva, may be more effective than distilled water in improving denture performance in patients with xerostomia.

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