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โครงการวิจัย

ผลของสารแช่ฟันเทียมและสารสี่ชนิดต่อความขรุขระพื้นผิวเรซินอะคริลิกที่บ่มด้วยความร้อน

The effect of a commercial denture cleansing solution and four solutions on surface roughness of heat cured acrylic resin

โดย

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ชื่อเรื่อง : ผลของสารแช่ฟันเทียมและสารสี่ชนิด
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รายงานการวิจัยเรื่องผลของสารแช่ฟันเทียมและสารสี่ชนิดต่อความขรุขระของพื้นผิว เรซินอะคริลิกที่บ่มด้วยความร้อนเป็นการวิจัยเชิงทดลองมุ่งศึกษาให้ทราบถึงความขรุขระของพื้นผิวเรซินอะคริลิกที่บ่มด้วยความร้อนหลังจากนำไปแช่ในน้ำส้มสายชู, กรดน้ำส้ม, โซเดียมไฮโปคลอไรด์ที่ความเข้มข้น 0.1% และ 0.5% และสารแช่ฟันเทียมเป็นระยะเวลา 12เดือนโดยงานวิจัยนี้เป็นการรวบรวมข้อมูลจากการนำชิ้นทดสอบเรซินอะคริลิคที่บ่มด้วยความร้อนรูปร่างทรงกระบอกมาแบ่งเป็น 6 กลุ่ม กลุ่มละ 12 ชิ้น ตามสารที่นำไปแช่ตามที่ได้กล่าวไปในข้างต้น รวมทั้งสิ้น 72 ชิ้น ซึ่งชิ้นทดสอบในแต่ละกลุ่มจะแช่ที่อุณหภูมิ 25 องศาเซลเซียสในสารดังกล่าวเป็น 10 นาทีต่อครั้ง วันละ 5 ครั้ง เป็นระยะเวลา 72 วัน เทียบเท่ากับ 12 เดือนของการใช้งานของฟันเทียมจริง หลังจากนั้นทดสอบหาค่าความขรุขระพื้นผิวของชิ้นทดสอบด้วยเครื่องวัดความหยาบพื้นผิวแบบไม่สัมผัส (รุ่น InfiniteFocus SL, Alicona, Austria) ก่อนแช่ และหลังแช่ 12 เดือน เพื่อดูว่าความขรุขระของพื้นผิวของเรซินอะคริลิกที่บ่มด้วยความร้อนว่าก่อนแช่และหลังแช่มีความแตกต่างกันหรือไม่ วิเคราะห์ข้อมูลใช้สถิติความแปรปรวนทางเดียวแบบวัดซ้ำ (one way repeated measures ANOVA) และวิธีการตูกี (Post hoc test; LSD and Turkey's HSD test)

โดยพบว่าหลังแช่ไป 12 เดือน ความขระขรุของพื้นผิวใน 0.1 และ 0.5% โซเดียมไฮโปคลอไรด์มีความแตกต่างอย่างมีนัยยะสำคัญทางสถิติ ในขณะที่น้ำส้มสายชู 100% และกรดอะซิติค 5% ไม่แตกต่างอย่างมีนัยยะสำคัญจากสารแช่ฟันเทียมเชิงพานิช (Polident®) ดังนั้นจึงสามารถเป็นอีกทางเลือกหนึ่งสำหรับแช่ทำความสะอาดฟันเทียมได้

Abstract

Title : The effect of a commercial denture cleansing solution and four different solutions on surface roughness of heat cured acrylic resin

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This research is an experimental study to compare the surface roughness of heat-cured acrylic resin after soaking commercial denture solution and 4 solutions; 0.1% and 0.5% sodium hypochlorite, vinegar and acetic acid and tap water to be a negative control. There are 6 groups for this experiment. 12 specimens for each group in 25 degree Celsius soaking in all solutions for 10 minutes in each cycle. 365 cycles are equivalent to 12 months. The surface roughness will be recorded at pre-immersion and post-immersion by surface roughness tester (InfiniteFocus SL, Alicona, Austria). The statistically analysis used in this study are one-way repeated measures ANOVA and Post hoc test (LSD and Turkey's HSD test).

After immersed 12 months in 0.1% and 0.5% sodium hypochlorite, the surface roughness showed significantly different results from the other groups. The 100% clear vinegar and 5% acetic acid showed little difference from Polident®, therefore these two can be used as alternatives for denture cleansing solutions.

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Chapter 1
Introduction

Background

Nowadays, Thailand is stepping into elderly society. Ministry of Social Development and Human Security showed that the elderly population is 16.06%, estimated from 66 million Thai population. The National Oral Health Survey by the Ministry of Health Dentistry, Department of Public Health shows that 1 million elderly people needed to wear complete dentures and 4.9 million people needed to wear removable partial dentures. From this information, the number of denture wearers is increasing every year but there is no definitely protocol for clean the denture as a gold standard. A recommendation from Thai Health Promotion Foundation for clean dentures are immersing it in tap water and brush their dentures with toothbrush and diluted soap or toothpaste. At present, the most acceptable method for clean a denture is to immerse in commercial denture cleansing solution. It leads to our study that is there any agents; which clean denture effectively and no statistically different from commercial cleansing solutions, which can be a better method to clean a denture rather than immersing in tap water and brush with toothbrush and diluted soap or toothpaste. Cleaning a denture is an important part of maintaining a good oral hygiene of denture wearers which leads to reduce the plaque accumulation on a denture surface.

The acrylic denture base; also known as acrylic is less stiff than other components of denture. The properties of denture base are required biocompatibility, dimensional stability, flexural strength and surface roughness. This study will focus on surface roughness which causes plaque accumulation and also increase the risk of oral disease afterward.

Factors to be considered of denture cleansing properties are antibacterial, plaque removal and material biocompatibility. The properties of denture cleansing should not alter denture properties. First of all, denture cleansing solution should not erode denture surface because the surface roughness, after immersion, will induce microorganism accumulation. Clinical acceptable value of surface roughness is 0.2 micron. (Curd M.L.Bollent et al.,1997)

Second, antibacterial properties, *Candidas albicans* is the most common opportunistic pathogen which is found in the oral cavity and caused oral disease such as denture stomatitis. That is the reason why antibacterial properties of denture cleansing solution is important.

Last but not least, cleansing solution and denture material compatibilities are directly relevant. Denture cleansing material properties should not affect denture material properties such as color change, dimensional stability, strength and especially surface roughness.

Objective

To evaluate the surface roughness of heat-cured acrylic resin among 4 different solutions and commercial denture cleansing solution when immersed for 12 months

Definition

Denture cleansing solution

Any products use to effectively clean dentures.

Clear vinegar

1. a sour liquid consisting of dilute and impure acetic acid, obtained by acetous fermentation from wine, cider, beer, ale, or the like: used as a condiment, preservative, etc.
2. Pharmacology. a solution of a medicinal substance in dilute acetic acid, or vinegar.

Acetic acid

a colorless pungent liquid acid $C_2H_4O_2$ that is the chief acid of vinegar and that is used especially in synthesis (as of plastics).

Sodium hypochlorite (NaOCl)

A clear, slightly yellowish solution with a characteristic odor. It is widely used in dental practice during root canal treatment and can be effectively used for water purification and also used on a large scale for surface purification, bleaching, odor removal and water disinfection.

Distilled water

Water from which impurities, as dissolved salts and colloidal particles, have been removed by one or more processes of distillation; chemically pure water.

Tap water

water as it comes from a tap (as in a home).

Surface roughness

The shorter frequency of real surfaces relative to the troughs

Heat-cured acrylic resin

In resins, a thermal activation of smaller molecular chain molecules to form a larger molecular chain; heat activates the benzoyl peroxide, an initiator, which will react with methyl methacrylate monomer to form poly-methyl methacrylate.

Scope of work

It is a quantitative study which focuses on the comparison of surface roughness of heat-cured acrylic resin after soaking in denture solution, vinegar, diluted acetic acid, 0.5% sodium hypochlorite, and 0.1% sodium hypochlorite.

Sample : disc-shaped of heat-cured acrylic resin 72 specimens, 10 millimeters in diameter and 2 millimeters in thickness

Duration : 1 year

Conceptual framework

Other than commercial denture cleansing solution, 4 different solutions; clear vinegar, diluted acetic acid, 0.5% sodium hypochlorite, and 0.1% sodium hypochlorite, are able to clean the denture due to the action of reducing plaque accumulation, but it also increase roughness the surface of heat-cured acrylic resin more irregular that leading to other oral diseases such as denture stomatitis respectively. In consequence, if the effect of surface roughness from vinegar, diluted acetic acid, 0.5% sodium hypochlorite, and 0.1% sodium hypochlorite does not different from commercial denture cleansing solution; statistically significant, there will be alternative choices for denture wearers.

Expected benefit

1. Beneficiary : Denture wearers, vinegar company, acetic acid company, bleach company
2. Affected : Denture cleansing solution company

Research Benefits

This research would be beneficial for denture wearers; especially those who are not able to clean denture effectively. An immersing method would be a good choice to clean denture for support both chemical and mechanical methods. If the agents have an effectiveness of cleansing as commercial denture cleansing with clinically acceptable roughness, they will be the alternative way for denture wearers.

Chapter 2
Review Literature

According to properties of denture base; flexural strength, dimensional stability, surface roughness and color stability. This study will be focused on surface roughness which is the cause of plaque accumulation.

The cleanliness of denture base is an important part to maintain good oral hygiene. The five denture cleansing solutions (0.1% and 0.5% sodium hypochlorite, vinegar and diluted acetic acid and commercial cleansing solution) were chosen to evaluate on surface roughness of heat-cured acrylic resin; controlled by tap water act as a negative control.

Vinegar, diluted acetic acid, 0.1% and 0.5% sodium hypochlorite have properties of chemical method and all these 4 solutions will be compared with commercial denture cleansing solution which have both mechanical and chemical methods.

There are two major approaches to provide efficient plaque control. The first is mechanical methods; physical cleansing methods such as brush and ultrasonics, is the most commonly used and effective procedure for reducing and removing biofilm formation (Shay K, 2000;Paranhos et al2013). The second is cleaning by chemical method mainly include soaking in a household or commercial solutions such as Alkaline peroxides, alkaline hypochlorite, acids, disinfectants (Gautham et al., 2016;Shay, 2000 and Paranhos et al., 2013).

Brushing a denture with a toothbrush can abrade denture surface and increase surface roughness. (Kurniawan et al.,2019) Then we will focus on solutions which also have a mechanical effect to clean a denture.

Basson showed the effectiveness of undiluted vinegar solutions in killing adherent microorganisms when used as disinfection agent for denture cleansing. According to Shay Kenneth, inadequate rinsing after soaking in vinegar does not result in mucosal damage which is one advantage of vinegar over bleach. Da Silva FC et al., Yildirim-Bicer AZ et al., advocated the use of 100% vinegar for 10 minutes as denture disinfectant especially against *Candida Albicans*.

Moreover, acid or plain household vinegar could attack the inorganic phosphate portion of denture deposit which result in reducing calculus accumulation on denture surface and it was also found to be effective in removing sordes and mucin.However,vinegar is less effective in killing microorganisms, in comparison to bleaching solution.
(Ejvind Budtz-Jorgensen et al, 1979).

Vinegars, in every brand, have many different components. The most important component of vinegar is 3-5% Acetic acid. That is the reason why we pick up diluted acetic

acid as one of immersing agents to find out that any other components of vinegar disturb denture surface roughness or not.

There was a study suggested using sodium hypochlorite at a 10-minute immersion effective in elimination of microorganisms from both superficial and inner surface of material (Chau 1995) and Desousaporta,2013 state that it was effective in reducing microorganisms without significant changes in colour or roughness of denture resin. 0.5% of NaOCl for 10 minutes immersion had best antimicrobial activity among various tested disinfectant (de Sousa Porta SR et al, 2015), however it increased surface roughness significantly (Prabal Sharma et al, 2017).

In terms of Oral Medication, 0.1% NaOCl is used for cleaning and disinfection in gastroenteritis outbreaks (Community and Public Health of Canterbury District Health Board). It confirmed that 0.1% of NaOCl does not harm the human gastrointestinal tract which is an interesting point. If the surface roughness of 0.1% NaOCl is not statistically different from 0.5% NaOCl, it will be a good choice and harmless solution of choice.

Denture cleansers can be categorized according to the active composition such as sodium perborate, sodium hypochlorite and alkaline peroxide(Porwal et al 2017;Vieira et al,2010).The dominant commercial formulations include compounds for oxidizing (usually an alkaline perborate), effervescing (perborate and/or carbonate), and chelating (EDTA).Detergent, color, and fragrance agents are present as well. The formulations are effective at essentially sterilizing a prosthesis when used overnight; they achieve a 99% kill rate of most organisms in the recommended 10 to 20 minute soaking time(Shay,2000).The bubbling action of effervescent solutions is reported to carry contaminants away from the denture surface (Raab et al.,1991; Shay K,2000).

Furthermore, immersion in cleansing solution is an inexpensive, easy, and comfortable alternative procedure and the cleansing solution can reach undercuts of the denture base that are difficult to clean mechanically, resulting in efficient cleansing which is in agreement with the studies of Garcia et al.,(2014) which states that commercial cleansers containing hydrogen peroxide could remove the pellicle and may be more effective in the cleaning of removable prosthesis without affecting surface hardness and roughness of either resin or dental alloys.However Boonsoe et al.,(2019) states that they can lead to reduction in color stability and the hardness of the denture base resin on long periods of immersion

Surface roughness of denture plays an important role in the process of bacterial retention.The study stated that clinically acceptable surface roughness is 0.2 micrometers that could decrease plaque accumulation(Bollen,1997).

The results of denture cleansers on the surface roughness of hard acrylic resin; by immersing in denture cleansers, show that there was not much difference in the mean surface roughness between pre-immersion and post-immersion values (Barochia et al.,2018). The

roughness of the acrylic resin samples immersed in the commercial cleanser was constant and less than that of those treated with the manipulated cleanser and water (Garcia et al.,2014).In addition,The denture base material did not reveal any clinical significant surface changes even after being immersed in effervescent tablets (Ural et al.,2011).

However, there are few studies claim that immersion acrylic resin in sodium perborate cleanser show a gradual increase in the roughness values as time duration increased but not statistically significant (Jeyapalan et al., 2015) which is in agreement with the studies of Peracini et al., 2010 ;that is, the commercial cleanser significantly increased the surface roughness of heat polymerized acrylic resin.

Although there are many studies showing that immersing acrylic resin denture base in commercial cleansing solution did not cause significant change in surface roughness, there are also the studies stated in vice versa. Another solution is 0.5%sodium hypochlorite, a study showed that it did not cause significant change in surface roughness. The others are clear vinegar and acetic acid, there are limited studies demonstrated surface roughness value of those solutions after immersion.

Chapter 3
Research Methodology

Population and sample sizes

From statistical analysis, sample size of this *in vitro* study is at least 54 in total. Number of group is 6 groups. A p-value less than 0.05 was set at statistically significant.

We used 72 disc-shaped of heat-cured resins which are 10 mm in diameter and 2 mm in thickness, specimens will be divided into 6 groups; 12 specimens per group.

Experimental Materials

1. Distilled water
2. 100% Clear vinegar (Suksapan®,Thailand)
3. 5% Acetic acid (Suksapan®,Thailand)
4. 0.1% Sodium Hypochlorite (Suksapan®,Thailand)
5. 0.5% Sodium Hypochlorite (Suksapan®,Thailand)
6. Commercial denture cleanser (Polydent®,Block drug company.inc,USA)
7. Beakers 250 ml
8. Filter cloths
9. Incubator
10. Forcep
11. Surface roughness analyzer(InfiniteFocus SL, Alicona®, Austria)
12. Heat-cure acrylic resin specimen (Vertex™, Dental B.V. Headquarters, The Netherlands)
13. Glove
14. Mask

Materials and methods

Disc-shaped Heat-cured acrylic resin specimen (Vertex™, Dental B.V. Headquarters, the Netherlands) size 10 millimeters in diameter and 2 millimeters in thickness immerse in 5 different solutions; denture cleansing solution (Polydent®,Block drug company.inc,USA), 0.1% sodium hypochlorite (Suksapan®,Thailand), 0.5% sodium hypochlorite (Suksapan®,Thailand), clear vinegar (ตรา®,PFO FOOD co.,ltd,thailand), acetic acid (Suksapan®,Thailand) and tap water (a negative control). There are 12 specimens in each solution and 72 specimens in total. All specimens will be stored at 25 degrees Celsius in an

incubator. Each group of specimens will be soaked in different solutions and solutions will be changed every 10 minutes, 40 cycles for each day. 12 months immersion will be represented by 365 cycles. The surface roughness tester (InfiniteFocus SL, Alicona®, Austria) will be set at a speed of 0.5 mm/s and will be used to measure and record the surface roughness of heat-cured acrylic resin before soaking and after soaking dentures in different solutions. The repeated ANOVA is statistically used to analyze by using LSD and Turkey's HSD for normality test.

Specimens preparation

72 disc-shaped of heat-cured resin which are 10 mm in diameter and 2 mm in thickness will be fabricated by using mold and invested in dental flask using dental stone(Type III gypsum).The mold used for the preparation of the test specimens will be applied by separating medium. The heat cured acrylic resin will be used in the powder-liquid form. The powder and liquid will be mixed in ratio as recommended by the manufacturer. When the mix reached the dough stage, it will be packed into mold space and processed according to manufacturer's instructions. Long cure cycle of polymerization (73°C for 90 minutes followed by 94°C for 30 minutes) will be done. The specimens will be removed from the molds and trimmed using tungsten carbide bur then green and white stone respectively. sandpaper no.600, 1000, 2000 and pumice will be used for polishing following by buffing polishing wheel, after that all specimens will be steamed for cleaning.

Specimens will be divided into 6 groups; 12 specimens per group, and immersed in

1. Distilled water (Negative control) for 10 minutes per day
2. Denture cleansing solution (Polydent®, Block drug company.inc, USA)10 minutes per day
3. Clear vinegar concentration 100% for 10 minutes per day
4. Acetic acid 5% for 10 minutes per day
5. Sodium hypochlorite 0.1% for 10 minutes per day
6. Sodium hypochlorite 0.5% for 10 minutes per day

After immersion in the respective solutions, each test specimen will be washed in distilled water for 2 minutes

Solutions	Conc.	Brand	Time (mins.)
Distilled water (negative control)	-	Suksapan®, Thailand	10
Denture cleansing solution	-	Polident®, Block drug company.inc, USA	10
Clear vinegar	100%	Suksapan®, Thailand	10
Acetic acid	5%	Suksapan®, Thailand	10
Sodium hypochlorite (NaOCl)	0.1%	Suksapan®, Thailand	10
Sodium hypochlorite (NaOCl)	0.5%	Suksapan®, Thailand	10

Table1: shows percent, brand, time of denture cleansing solution and 4 household agents

Data Collection

The surface roughness of specimens will be measured immediately (T0) after delivered, by control in 25 degree Celsius environment.

After immersing specimens in denture cleansers and distilled water for 12 months (follow the cycle of experimental design), the specimens will be remeasured and recorded a result (T12).

Materials/time	12 months (hrs.)	Time included washing period (plus 2 mins) (hrs.)	Day count for each experimental (8 hours per day)	Cycles in 1 day
Distilled water (10 minutes per day)	60.84	-	-	-
Denture cleansing solution (10 minutes per day)	60.84	73	9.13(10)	40.00(40)
Clear Vinegar 100% (10 minutes per day)	60.84	73	9.13(10)	40.00(40)
Acetic acid 5% (10 minutes per day)	60.84	73	9.13(10)	40.00(40)
Sodium Hypochlorite 0.5% (10 minutes per day)	60.84	73	9.13(10)	40.00(40)
Sodium Hypochlorite 0.1% (10 minutes per day)	60.84	73	9.13(10)	40.00(40)

Table2: shows the cycles that represented 12 months of immersion

We will do experiments for 40 cycles each day. It represents 10 days for 365 cycles equivalent to the immersion time of 12 months.

Data analysis

The statistical analysis used in this study are one-way repeated measures ANOVA and Post hoc test(LSD and Turkey's HSD test)

Chapter 4
Result and Discussion

Results

Before immersion, the surface roughness of the 72 specimens were measured through Alicona®.

Table3: The one-way analysis of variance (ANOVA) in pre-immersion (T0)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	41.058	5	8.212	0.1029	0.991
Within Groups	5292.819	66	80.194		
Total	5333.877	71			

From Table 2, the one-way ANOVA was used to analyze the pre-immersion specimen. The results show that all groups were not significantly different at T0 (pre-immersion), confirming that all specimens had the same surface roughness.

The descriptive analysis is used to show information including mean and standard deviation of surface roughness as presented in the Table 3.

Table4: The mean average surface roughness (Ra) values of the heat-cured acrylic resin due to the interaction between period and immersion solutions for pre-immersion (T0) and post-immersion (T12).

Table	N	Ra of T0 (nm)		Ra of T12 (nm)	
		Mean	S.D.	Mean	S.D.
Tap water	12	195.58	8.69	196.15	11.00
Polident®	12	195.13	8.92	200.11	11.12

Table	N	Ra of T0 (nm)		Ra of T12 (nm)	
		Mean	S.D.	Mean	S.D.
100% clear vinegar	12	196.04	8.92	197.77	8.69
5% Acetic acid	12	195.64	8.942	200.17	7.43
0.1% NaOCl	12	193.71	10.55	229.07	13.88
0.5% NaOCl	12	194.76	7.42	235.70	11.15
Total	72	195.14	8.67	209.83	19.26

From Table 3, the cleansing solutions (GROUP) for pre-immersion (T0) and post-immersion (T12) have the mean average surface roughness (Ra) values between 193.71 nm to 196.04 nm and 196.145 nm. to 235.70 nm, respectively.

Table5: Tests of Within-Subjects Contrasts

Source	Sum of Squares	df	Mean Square	F	Sig.
TIME	7762.051	1	7762.051	600.311	.000
TIME * GROUP	10083.295	5	2016.659	155.967	.000
Error(TIME)	853.383	66	12.930		

Table6: Tests of Between-Subjects Effects

Source	Sum of Squares	df	Mean Square	F	Sig.
Intercept	5904069.779	1	5904069.779	32309.065	.000
GROUP	8674.912	5	1734.982	9.494	.000
Error	12060.659	66	182.737		

The results of repeated measures of one-way ANOVA in Tables 4 and 5 show that the null hypothesis is rejected (α=0), the mean difference of surface roughness values for all cleansing solutions (GROUP) has at least one pair that shows statistical significance. Therefore, to find the mean difference of surface roughness values of all cleansing solutions, there must be multiple comparisons by using Tukey's HSD test for Post-Hoc analysis test as shown in Table 6.

Table7: Results of Tukey Test for Post-Hoc Analysis

GROUP	N	Subset	
		1	2
Tap water	12	195.8637	-
100% clear vinegar	12	196.9054	-
Polident®	12	197.6179	-
5% acetic acid	12	197.9042	-
0.1% NaOCl	12	-	211.3913

GROUP	N	Subset	
		1	2
0.5% NaOCl	12	-	215.2321
Sig.		.995	.921

From study results shown in Table 6, cleansing solutions that are not different can be grouped as follows:

· Group 1: Tap water, Clear vinegar, Polident®, and 5% Acetic acid.

· Group 2: 0.1% and 0.5% NaOCl.

According to the recommendation, the surface roughness should be less than 200 nm. The result of Surface roughness at T12 in group 1 is not significantly different but in group 2 is significantly different (the table will be shown in appendix).

Discussion

This study evaluated the surface roughness of acrylic resin denture base due to the chemical cleansing method after immersed in tap water, Polident®, and 4 household agents. All specimens were controlled to have no significant difference before the process.

After the immersion process, the surface roughness showed no significant difference in control groups, 100% clear vinegar, and 5% acetic acid. On the contrary, both 0.1% and 0.5% sodium hypochlorite showed an increase in surface roughness significantly.

Due to the result of surface roughness between clear vinegar and 5% acetic acid were not scientifically different. Therefore, clear vinegar can be an alternative option for denture cleansing because it is easy to obtain and its antibacterial and antifungal effect. Acidic component of a clear vinegar which is acetic acid can denature bacterial and fungal membranes. The result of this study is similar to Sharma, Garg and Kalra (2017) who found that the surface roughness of the denture base did not cause much change after being immersed in the 100% vinegar and denture cleansing solution.

However, sodium hypochlorite increased surface roughness significantly which was similar to the studies of Porwal, Khandelwal, Punia and Sharma (2017); Paranhos et al. (2014) who found that sodium hypochlorite caused change in surface roughness of acrylic. Sodium

hypochlorite also resulted in an increase in surface roughness as compared to 100% vinegar thus, can be detrimental to prosthesis when used for 10 minutes (Sharmal et al., 2017).

In this study, both 0.1% and 0.5% sodium hypochlorite increased surface roughness significantly. Arruda et al. (2018) stated that 0.1% sodium hypochlorite is still effective on biofilm removal when used in participants with denture stomatitis. Therefore, 0.1% sodium hypochlorite would be a better choice for cleansing denture than 0.5% sodium hypochlorite because it has less toxicity and adequate biofilm removal. 0.05% sodium hypochlorite was employed due to its antimicrobial properties (Paranhos et al., 2014).

Furthermore, additional studies on the antimicrobial properties of the household agents on the acrylic resin denture base should be investigated.

Chapter 5
Conclusion

Conclusion

This study investigated the surface roughness of heat-cured acrylic resin among 4 groups of household agent solutions and commercial denture cleansing solution; immersed 10 minutes per day for 12 months. Immersion in 0.1% and 0.5% sodium hypochlorite, showed significantly different results from the other groups. The 100% clear vinegar and 5% acetic acid showed little difference from Polident® which is a representative of commercial denture cleansing solutions. Concluding that 100% clear vinegar or 5% acetic acid which are household agents can be used as alternatives for denture cleansing solutions for the elderly people in rural areas for routine use.

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Appendix

The result of Post hoc analysis for Ra at T12 among household agents, Polident and acceptable value Ra

Multiple Comparisons

Dependent Variable: RA12
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
acceptable value Ra	Polident®	-.10917	4.06152	1.000	-12.4061	12.1878
	100% clear vinegar	2.23000	4.06152	.998	-10.0669	14.5269
	5% acetic acid	-.16917	4.06152	1.000	-12.4661	12.1278
	0.1% NaOCl	-29.06667*	4.06152	.000	-41.3636	-16.7697
	0.5% NaOCl	-35.70083*	4.06152	.000	-47.9978	-23.4039
	Tap water	3.85000	4.06152	.963	-8.4469	16.1469
Polident®	acceptable value Ra	.10917	4.06152	1.000	-12.1878	12.4061
	100% clear vinegar	2.33917	4.06152	.997	-9.9578	14.6361

	5% acetic acid	-.06000	4.06152	1.000	-12.3569	12.2369
	0.1% NaOCl	-28.95750*	4.06152	.000	-41.2544	-16.6606
	0.5% NaOCl	-35.59167*	4.06152	.000	-47.8886	-23.2947
	Tap water	3.95917	4.06152	.958	-8.3378	16.2561
100% clear vinegar	acceptable value Ra	-2.23000	4.06152	.998	-14.5269	10.0669
	Polident®	-2.33917	4.06152	.997	-14.6361	9.9578
	5% acetic acid	-2.39917	4.06152	.997	-14.6961	9.8978
	0.1% NaOCl	-31.29667*	4.06152	.000	-43.5936	-18.9997
	0.5% NaOCl	-37.93083*	4.06152	.000	-50.2278	-25.6339
	Tap water	1.62000	4.06152	1.000	-10.6769	13.9169
5% acetic acid	acceptable value Ra	.16917	4.06152	1.000	-12.1278	12.4661
	Polident®	.06000	4.06152	1.000	-12.2369	12.3569
	100% clear vinegar	2.39917	4.06152	.997	-9.8978	14.6961
	0.1% NaOCl	-28.89750*	4.06152	.000	-41.1944	-16.6006

	0.5% NaOCl	-35.53167*	4.06152	.000	-47.8286	-23.2347
	Tap water	4.01917	4.06152	.955	-8.2778	16.3161
0.1% NaOCl	acceptable value Ra	29.06667*	4.06152	.000	16.7697	41.3636
	Polident®	28.95750*	4.06152	.000	16.6606	41.2544
	100% clear vinegar	31.29667*	4.06152	.000	18.9997	43.5936
	5% acetic acid	28.89750*	4.06152	.000	16.6006	41.1944
	0.5% NaOCl	-6.63417	4.06152	.661	-18.9311	5.6628
	Tap water	32.91667*	4.06152	.000	20.6197	45.2136
0.5% NaOCl	acceptable value Ra	35.70083	4.06152	.000	23.4039	47.9978
	Polident®	35.59167	4.06152	.000	23.2947	47.8886
	100% clear vinegar	37.93083	4.06152	.000	25.6339	50.2278
	5% acetic acid	35.53167*	4.06152	.000	23.2347	47.8286
	0.1% NaOCl	6.63417*	4.06152	.661	-5.6628	18.9311

	Tap water	39.55083	4.06152	.000	27.2539	51.8478
Tap water	acceptable value Ra	-3.85000	4.06152	.963	-16.1469	8.4469
	Polident®	-3.95917	4.06152	.958	-16.2561	8.3378
	100% clear vinegar	-1.62000	4.06152	1.000	-13.9169	10.6769
	5% acetic acid	-4.01917*	4.06152	.955	-16.3161	8.2778
	0.1% NaOCl	-32.91667*	4.06152	.000	-45.2136	-20.6197
	0.5% NaOCl	-39.55083	4.06152	.000	-51.8478	-27.2539

*. The mean difference is significant at the 0.05 level

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