

Effect of 2% Sodium Hypochlorite, Denture Cleansing Tablet and Tea on the Discolouration and Surface Roughness on Two Types of Denture Acrylic Resin: An In vitro Study

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ABSTRACT

Introduction: Denture cleansers affect the physical properties of denture materials, such as colour and surface roughness. Using denture cleanser with the least side effects in the best choice. There are only limited studies available evaluating the effects of denture cleaners in association with staining solutions on acrylic resins.

Aim: This study aimed to investigate the effect of denture cleansers in association with staining solution (tea), on the denture colour and surface roughness.

Materials and Methods: In this in vitro study conducted at Dental Faculty of Tabriz Medical University of Science, Tabriz, East Azarbaijan, Iran, from May 2018 to June 2019, 56 samples each were prepared from two types of acrylic resin (Acrosun and TDV Dental). The 2% Sodium Hypochlorite (NaOCl) solution and professional cleansing tablets were used as detergents, and tea was used as a dye. The samples were assigned to seven groups (n=8 samples in each group) for each type of acrylic used. The study groups consisted of group 1 (NaOCl solution for 10 minutes), group 2 (NaOCl solution for 8 hours), group 3 (cleansing tablet solution for 8 hours), group 4 (tea solution for 2 hours), group 5 (first tea solution and then NaOCl), group 6

(tea solution and then cleansing tablets) and group 7 (distilled water). Surface roughness was analysed with Ra and Rz indices, and colour changes were evaluated with CIELAB index before and after the experiment, and the data were recorded. Finally, data analysis was performed with Statistical Package for the Social Sciences (SPSS) version 21.0. The p-value less than 0.05 was considered as significant.

Results: The results of 112 disk-shaped samples prepared showed that in all the study groups, the colour change of Acrosun acrylic resin was more severe compared to that in TDV dental acrylic resin, which was significant only in groups 1, 2, and 5 (p-value <0.05). Comparison of the mean Ra index showed that surface roughness was the maximum and minimum in groups 6 and 1, respectively, compared to other groups. A comparison of the effect of different cleaning methods on acrylic resin surface roughness showed that the surface roughness indices of Ra and Rz were not significantly different in any of the groups (p-value >0.05).

Conclusion: The two types of acrylic resin did not differ significantly in surface roughness after the experiments. However, the TDV dental acrylic resin was superior in terms of colour stability.

Keywords: Colourimetry, Colour stability, Physical characteristic, Spectrophotometry, Surface properties

INTRODUCTION

Cleaning of dentures should be considered both in terms of removing dyes and food debris and eliminating microorganisms [1]. The use of chemical disinfectants is one of the methods for cleaning dentures; these agents affect the physical properties of denture materials, such as colour and surface roughness, in addition to an antimicrobial effect and increasing the denture hygiene [2-4]. Increased surface roughness is a factor that increases microbial plaque formation and food impaction and promotes microorganism colonisation, ultimately changing the denture colour, irritating the mucosa, and increasing inflammation of the tissues around the prosthesis [1-6]. Therefore, the selection of proper disinfectants and their correct application reduces their side effects [7]. Furthermore, the type of acrylic resin might also affect its colour stability and surface roughness, necessitating the evaluation of various factors involved.

A previous study evaluated the colour stability of denture acrylic resins and soft lining materials against tea, coffee, and nicotine and found significant colour changes in heat polymerised and injection-moulded acrylic resins immersed in coffee and soft lining materials immersed in nicotine solutions [4].

In another study, the colour changes after immersion in solutions were clinically insignificant. Bony plus as a denture cleanser showed

significantly increased surface roughness [8]. A study in 2020 evaluated the effect of coffee, denture cleanser and coffee with denture cleansers on colour stability of differently polymerised denture base acrylic resins. Immersion in denture cleanser and coffee solution caused significant colour changes in acrylic resin denture bases. It was observed that using denture cleaner after coffee could not bleach the acrylic denture base resins [9].

There are only limited studies available evaluating the effects of denture cleaners in association with staining solutions on acrylic resins [8,9]. The present study aimed to investigate the effect of two common disinfectants (sodium hypochlorite and prosthesis cleansing tablets) in association with tea as a staining solution on the surface roughness and rate of discolouration of two types of heat cured acrylic resin at different time intervals.

MATERIALS AND METHODS

This in vitro study was performed at the Dental Faculty of Tabriz University of Medical Science at Tabriz, East Azarbaijan, Iran, from May 2018 to Jun 2019.

A total of 112 disk-shaped samples were prepared from Acrosun (Betadent, Iran) and TDV dental (Brazil) acrylic resins (n=56 for each type of acrylic used), measuring 20 mm in diameter and 2 mm in thickness. Each acrylic resin type was further divided into seven groups of eight samples each.

A special mould was designed to fabricate the acrylic blocks. After mixing, the acrylic resin was packed into the mould according to the manufacturers' instructions and placed in boiling water. After 24 hours at room temperature, the acrylic samples were retrieved, and the excess resin was trimmed.

Polishing of the Samples

All the samples were polished until a glossy and shiny surface was achieved. Special kits (Microdent Polident, Brazil) and special 400-grit- and 600-grit polishing sandpaper (Sankyo Rikagaku Co., Ltd., Saitama, Japan) were used two times for three minutes for polishing. The samples were polished by one operator, and a new paper was used for each sample. Finally, the samples were washed and towel dried. The acrylic samples were measured before and after placement in experimental solutions in terms of surface roughness, using Ra and Rz indices, and discolouration using a*, b*, and L* indices.

In the present study, Swiss made Bonyf professional cleansing effervescent tablets (sodium bicarbonate and potassium monopersulfate) and NaOCl solution (MEHTAJ Co., Iran) were used as cleaning agents, and Golestan teabags (Iran) were used as a staining solution. Distilled water (Pars Shimi Company, Tehran, Iran) was used in the control group.

The colour characteristics of the samples were measured using a UV160 spectrophotometer. The International Commission on Illumination (CIE) L*a*b* system is used commonly in dentistry to determine colour change in dental materials. Colourimeter instruments measure three parameters of colour; L* (lightness), a* (red/green), and b* (yellow/blue). ΔE is the colour difference between two specimens, as calculated by the following formula [9]:

$$\Delta E = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

The roughness of sample surfaces was measured using a profilometer (Surtronic, Taylor Hobson Company, England).

The samples were placed on the table, and the device's probe was moved on the surface of the sample. The surface roughness was displayed as a value on the screen of the device; then, the data were recorded. The device was moved in the direction of the sample's diameter [8-12].

Ra measures the average length between the peaks and valleys and the deviation from the mean line on the entire surface within the sampling length.

Rz measures the vertical distance from the highest peak to the lowest valley within five sampling lengths and averages the distances.

The groups in this study were the following:

Group 1: Immersion in 2% NaOCl solution for 10 minutes and then stored in distilled water for one month.

Group 2: Immersion in 2% NaOCl solution for eight hours and then stored in distilled water for one week.

Group 3: Immersion in the cleansing tablet solution for eight hours and then stored in distilled water for one week.

Group 4: Immersion in tea for two hours and then stored in distilled water for one month.

Group 5: Immersion in tea for two hours and then in 2% NaOCl solution for 10 minutes and distilled water for one month.

Group 6: Immersion in tea for two hours and then in the cleansing tablet solution for eight hours and distilled water for one month.

Group 7: Immersion in distilled water for one month (control group).

STATISTICAL ANALYSIS

Data were analysed with Statistical Package for the Social Sciences (SPSS) version 21.0. The statistical significance level was set at p-value <0.05. Data distribution was first investigated using the Kolmogorov-Smirnov test. One-way Analysis of variance (ANOVA) was used to compare the mean surface roughness and colour changes between the groups due to the normal distribution of data. Post-hoc tests were used to evaluate the mean difference between the paired groups. When the variances were homogeneous, the Tukey's HSD (Honestly Significant Difference) test was used, and when the variances were not homogeneous, the Dunnett T3 test was used. Finally, the independent sample t-test was used to examine the mean difference between the acrylic resin groups of the two manufactures (two-by-two comparisons) due to the normal distribution of data.

RESULTS

Colour Change (ΔE) Evaluation

Comparison of colour changes (ΔE) in different groups of Acrosan acrylic samples showed that the mean changes in group 4 (acrylic resin samples exposed to tea solution for two hours every day for a month) were higher compared to other groups; in the control group, the changes were lowest compared to the other groups. One-way ANOVA showed that the differences between the groups were significant (p-value <0.001) [Table/Fig-1].

Comparison of colour changes (ΔE) in different groups of TDV acrylic samples showed that the mean changes in group 4 (acrylic resin samples exposed to tea solution for two hours every day for a month) were higher compared to other groups; in the control group, the changes were lowest compared to the other groups. One-way ANOVA showed that the differences between the groups were significant (p-value <0.001) [Table/Fig-2].

Group	Control (Group 7)	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Number	8	8	8	8	8	8	8
Mean	0.349	1.154	1.129	0.883	1.220	1.038	0.701
Standard deviation	0.168	0.194	0.187	0.229	0.180	0.224	0.196
Minimum	0.132	0.915	0.754	0.518	0.934	0.827	0.235
Maximum	0.660	1.445	1.337	1.248	1.409	1.531	0.821
Test results	F value: 19.627			p-value <0.001** (statistically highly significant)			

[Table/Fig-1]: Comparison of colour changes (ΔE) in different groups of Acrosan acrylic samples using one-way ANOVA test.

Group	Control (Group 7)	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Number	8	8	8	8	8	8	8
Mean	0.312	0.780	0.919	0.954	1.153	0.687	0.615
Standard deviation	0.152	0.198	0.159	0.316	0.153	0.289	0.137
Minimum	0.099	0.546	0.693	0.616	0.899	0.197	0.450
Maximum	0.469	0.997	1.072	1.461	1.334	1.019	0.805
Test Results	F value: 12.027			p-value <0.001** (statistically highly significant)			

[Table/Fig-2]: Comparison of colour changes (ΔE) in different groups of TDV acrylic samples using one-way ANOVA test.

Groups 1, 2, 3, 4, 5, and 6 of Acrosun acrylic resin were compared to investigate the colour changes in different disinfection techniques and the effect of these techniques after exposure to tea solution. The independent samples t-test showed significant difference in comparisons between groups (1 and 3), (5 and 6) and (2 and 3) and (4 and 6) [Table/Fig-3].

Acrosun	Mean	Standard deviation	p-value
Group 1	1.15413	0.193984	0.023*
Group 3	0.88263	0.228900	
Group 1	1.15413	0.193984	0.285
Group 5	1.03787	0.223644	
Group 2	1.12863	0.187445	0.034*
Group 3	0.88263	0.228900	
Group 2	1.12863	0.187445	0.394
Group 5	1.03787	0.223644	
Group 4	1.21938	0.180428	0.096
Group 5	1.03787	0.223644	
Group 4	1.21938	0.180428	0.001**
Group 6	0.70050	0.195532	
Group 6	0.70050	0.195532	0.109
Group 3	0.88263	0.228900	
Group 6	0.70050	0.195532	0.006*
Group 5	1.03787	0.223644	

[Table/Fig-3]: Comparison of colour change differences according to various disinfection techniques in acrosun acrylic groups using the independent samples t-test. *p-value statistically significant; ** highly significant

Groups 1, 2, 3, 4, 5, and 6 of TDV acrylic resin were compared to investigate the colour changes in different disinfection techniques and the effect of these techniques after exposure to tea solution. The Independent-samples t-test showed significant difference in comparisons between groups (3 and 6) and (4 and 6) and (4 and 5) [Table/Fig-4].

TDV	Mean	Standard deviation	p-value
Group 1	0.78025	0.197590	0.208
Group 3	0.95425	0.316215	
Group 1	0.78025	0.197590	0.466
Group 5	0.68750	0.288612	
Group 2	0.91900	0.158869	0.782
Group 3	0.95425	0.316215	
Group 2	0.91900	0.158869	0.067
Group 5	0.68750	0.288612	
Group 4	1.15275	0.152768	0.001*
Group 5	0.68750	0.288612	
Group 4	1.15275	0.152768	0.001**
Group 6	0.61463	0.137086	
Group 6	0.61463	0.137086	0.015*
Group 3	0.95425	0.316215	
Group 6	0.61463	0.137086	0.529
Group 5	0.68750	0.288612	

[Table/Fig-4]: Comparison of colour change differences in various disinfection techniques in TDV dental acrylic groups using the independent samples t-test. *p-value statistically significant; **highly significant

Investigation and Comparison of Colour Changes of Acrosun and TDV Dental Acrylic Resins in Disinfectants

In groups 1 and 2, the colour changes in the Acrosun acrylic resin were greater compared to that in TDV dental acrylic resin. The independent samples t-test showed that the difference between the two groups was significant p-value=0.002* and p-value=0.03*, respectively. In group 3, the colour changes of Acrosun acrylic

were greater compared to TDV dental acrylic resin. However, the independent samples t-test showed that the difference between the two groups was not significant [Table/Fig-5].

Group	Number	Mean	ST	Mini- mum	Maxi- mum	T-test	p-value	
Group 1	Acrosun	8	1.154	0.194	0.915	1.445	0.0844	0.002*
	TDV	8	0.78	0.198	0.546	0.997		
Group 2	Acrosun	8	1.129	0.187	0.754	1.337	2.867	0.030*
	TDV	8	0.919	0.159	0.693	1.072		
Group 3	Acrosun	8	0.883	0.229	0.518	1.248	0.519	0.621
	TDV	8	0.954	0.316	0.616	1.461		
Group 4	Acrosun	8	1.22	0.18	0.934	1.409	0.439	0.797
	TDV	8	1.153	0.153	0.899	1.334		
Group 5	Acrosun	8	1.038	0.224	0.827	1.531	2.714	0.017*
	TDV	8	0.687	0.289	0.197	1.019		
Group 6	Acrosun	8	0.701	0.196	0.235	0.821	1.017	0.326
	TDV	8	0.615	0.137	0.45	0.805		

[Table/Fig-5]: Comparison of the colour changes of Acrosun and TDV dental acrylic resins in various groups using the independent samples t-test.

Investigation and Comparison of Colour Changes of Acrosun and TDV Dental Acrylic Resins in Tea

Group 4 consisted of acrylic resin samples exposed to tea solution. Colour change in the Acrosun acrylic resin group was more severe compared to that in TDV dental acrylic resin. However, independent samples t-test showed that the difference between these two groups was not significant, p-value=0.797 [Table/Fig-5].

Investigation and Comparison of Colour Changes of Acrosun and TDV Dental Acrylic Resin Samples in Tea and then in Disinfectants

In group 5, the colour changes in the Acrosun acrylic resin were greater compared to the TDV dental acrylic resin. Independent-samples t-test showed a significant difference between these two acrylic resins, p-value=0.017* [Table/Fig-5]. In group 6, Acrosun acrylic resin samples exhibited more colour changes. However, independent samples t-test showed no significant difference between them, p-value=0.326 [Table/Fig-5].

Surface Roughness Evaluation (Ra and Rz indices)

Ra index shows the overall surface roughness.

Comparison of the Ra indexes in acrosun acrylic resin samples showed that the average Ra index in group 6 was higher than that in other groups. In group 1, it was lower than that in other groups. One-way ANOVA showed that the differences between the groups were significant, p-value=0.025* [Table/Fig-6].

Group	7	6	5	4	3	2	1
Number	8	8	8	8	8	8	8
Mean	1.052	1.409	1.181	1.382	0.995	1.284	0.876
Standard deviation	0.330	0.524	0.293	0.276	0.270	0.404	0.348
Minimum	0.673	0.645	0.640	1.086	0.588	0.509	0.426
Maximum	1.529	1.921	1.644	1.951	1.482	1.892	1.412
Test result	F=2.518		p-value=0.025* (statistically significant)				

[Table/Fig-6]: Comparison of the Ra indexes in Acrosun acrylic resin samples using One-way ANOVA test.

Comparison of the Ra indexes in TDV acrylic resin samples showed that the average Ra index in group 6 was higher than that in other groups. In group 1, it was lower than that in other groups. One-way ANOVA showed no significant differences between the groups [Table/Fig-7].

Overall comparison of the Ra indexes (regardless of acrylic resin type) showed that the average Ra index in group 6 was higher than

Group	7	6	5	4	3	2	1
Number	8	8	8	8	8	8	8
Mean	0.936	1.304	1.256	1.066	1.143	1.025	1.093
Standard deviation	0.215	0.330	0.254	0.394	0.290	0.379	0.331
Minimum	0.717	0.778	0.923	0.331	0.835	0.367	0.701
Maximum	1.296	1.723	1.659	1.544	1.784	1.417	1.603
Test result	F=1.298			p-value=0.276			

[Table/Fig-7]: Comparison of the Ra indexes in TDV dental acrylic resin samples using one-way ANOVA test.

that in other groups. In group 1, it was lower than that in other groups. One-way ANOVA showed that the differences between the groups were significant [Table/Fig-8].

Group	7	6	5	4	3	2	1
Number	16	16	16	16	16	16	16
Mean	0.994	1.356	1.218	1.224	1.069	1.155	0.985
Standard deviation	0.275	0.427	0.268	0.367	0.281	0.401	0.347
Minimum	0.673	0.645	0.640	0.331	0.588	0.367	0.426
Maximum	1.529	1.921	1.659	1.951	1.784	1.892	1.603
Test result	F-value=2.509			p-value=0.026* (statistically significant)			

[Table/Fig-8]: Comparison of the Ra indexes (regardless of acrylic resin type) using one-way ANOVA test.

Rz Index

Comparison of Rz index in acrosun acrylic resin samples and all samples regardless of acrylic resin type showed that the mean Rz index in group 6 was higher compared to other groups, with the lowest value in group 1. One-way ANOVA test showed that the differences between the groups were not significant (p-value=0.874) [Table/Fig-9].

Group	7	6	5	4	3	2	1
Number	8	8	8	8	8	8	8
Mean	4.146	4.879	4.542	4.388	4.134	4.545	3.619
Standard deviation	1.254	1.736	0.821	1.074	0.615	1.388	1.294
Minimum	2.306	2.555	3.264	3.131	3.275	3.377	1.806
Maximum	6.207	6.621	5.643	6.236	5.199	7.657	5.582
Test result	F=1.521			p-value=0.874			

[Table/Fig-9]: Comparison of the Rz indexes in Acrosun acrylic resin samples using One-way ANOVA test.

Comparison of the Rz indexes (regardless of acrylic resin type) using one-way ANOVA test showed that the difference was not significant (p-value=0.258) [Table/Fig-10].

Group	7	6	5	4	3	2	1
Number	16	16	16	16	16	16	16
Mean	3.699	4.464	4.168	4.269	3.993	4.013	3.599
Standard deviation	1.056	1.538	0.892	0.843	0.679	1.224	1.015
Minimum	2.306	2.439	2.657	3.128	2.850	2.506	1.806
Maximum	6.207	6.621	5.643	6.236	5.238	7.657	5.582
Test result	F=1.314			p-value=0.258			

[Table/Fig-10]: Comparison of the Rz indexes (regardless of acrylic resin type) using one-way ANOVA test.

Comparison of Rz index in TDV acrylic resin samples showed that the mean Rz index in group 6 was higher compared to other groups, with the lowest value in group 7. One-way ANOVA test showed that the differences between the groups were not significant (p-value=0.329) [Table/Fig-11].

Group	7	6	5	4	3	2	1
Number	8	8	8	8	8	8	8
Mean	3.252	4.151	3.794	4.050	3.852	3.480	3.579
Standard deviation	0.602	0.579	0.842	1.290	0.751	0.799	0.730
Minimum	2.554	3.128	2.657	2.439	2.850	2.506	2.134
Maximum	4.086	4.991	4.561	5.712	5.238	4.710	4.404
Test result	F-value=1.186			p-value=0.329			

[Table/Fig-11]: Comparison of the Rz indexes in TDV acrylic resin samples using one-way ANOVA test.

Investigation and Comparison of Acrosun and TDV Dental Acrylic Resin Surface Roughness in the Disinfectants

In groups 1 and 2, surface roughness (Ra and Rz) in the Acrosun acrylic resin was higher compared to that in the TDV acrylic resin. However, the independent sample t-test showed that the difference between the two groups was not significant in either case. In group 3, the surface roughness (Ra and Rz) in the TDV dental acrylic resin was higher compared to that in the Acrosun acrylic resin. However, the independent samples t-test showed that the difference between the two groups was not significant in either case [Table/Fig-12]. In groups 4, 5 and 6, the independent samples t-test showed that the difference between the two groups was not significant in either case [Table/Fig-12].

Rz	Group	Number	Mean	ST	Minimum	Maximum	T-test	p-value
Group 1	Acrosun	8	3.619	1.294	1.806	5.582	0.0761	0.9404
	TDV	8	3.579	0.73	2.134	4.404		
Group 2	Acrosun	8	4.545	1.388	3.377	7.657	1.880	0.080
	TDV	8	3.48	0.799	2.506	4.71		
Group 3	Acrosun	8	4.134	0.615	3.275	5.199	0.821	0.425
	TDV	8	3.852	0.751	2.85	5.238		
Group 4	Acrosun	8	4.388	1.074	3.131	6.236	0.549	0.591
	TDV	8	4.151	0.579	3.128	4.991		
Group 5	Acrosun	8	4.542	0.821	3.264	5.643	1.798	0.094
	TDV	8	3.794	0.843	2.657	4.561		
Group 6	Acrosun	8	4.879	1.736	2.555	6.621	1.083	0.2967
	TDV	8	4.049	1.289	2.439	5.712		
Ra	Group	Number	Mean	ST	Minimum	Maximum	T-test	p-value
Group 1	Acrosun	8	1.093	0.331	0.701	1.603	1.2779	0.2221
	TDV	8	0.876	0.348	0.426	1.412		
Group 2	Acrosun	8	1.284	0.404	0.509	1.892	1.322	0.2074
	TDV	8	1.025	0.379	0.367	1.417		
Group 3	Acrosun	8	1.143	0.29	0.835	1.784	1.05647	0.31
	TDV	8	0.995	0.27	0.588	1.482		
Group 4	Acrosun	8	1.066	0.394	0.331	1.544	1.867	0.082
	TDV	8	1.382	0.276	1.086	1.951		
Group 5	Acrosun	8	1.256	0.254	0.923	1.659	0.5413	0.596
	TDV	8	1.181	0.293	0.64	1.644		
Group 6	Acrosun	8	1.304	0.330	0.778	1.723	0.4811	0.6379
	TDV	8	1.409	0.524	0.645	1.921		

[Table/Fig-12]: Comparison of Acrosun and TDV dental acrylic resin surface roughness (Ra and Rz) in all the groups using the independent samples t-test.

Investigation and Comparison of the Impact of Groups 1, 2 and 3 on Acrylic Resin Surface Roughness

This study was performed to compare the effect of different irrigation methods on acrylic resin surface roughness. The results of one-way ANOVA showed that the surface roughness indices of Ra and Rz were not significantly different in any of the study groups [Table/Fig-13].

Variables	Group 3	Group 2	Group 1	Group 3	Group 2	Group 1
	Rz			Ra		
Number	16	16	16	16	16	16
Mean	3.993	4.013	3.599	1.069	1.155	0.985
Standard deviation	0.679	1.224	1.015	0.281	0.401	0.347
Minimum	2.850	2.506	1.806	0.588	0.367	0.426
Maximum	5.238	7.657	5.582	1.784	1.892	1.603
Test results	p-value=0.425			p-value=0.310		

[Table/Fig-13]: Comparison of the impact of groups 1, 2 and 3 on acrylic resin surface roughness using one-way ANOVA test

DISCUSSION

Denture disinfection might result in changes in the physical properties of the denture base. A previous study had suggested different materials and durations for denture cleaning and disinfection [13]. It is of clinical significance to determine whether denture detergents alter the acrylic resins' properties. If the disinfection methods are not used properly, changes are possible in the colour of the denture base polymers [13]. Denture fading also occurs due to the high temperature of the water used. Also, discolouration could result from aging or damage to the denture [14].

Irregularities and porosities on the denture surface collect stains and microbial plaque [15]. Surface roughness is considered a critical clinical factor in the formation of biofilms and makes it difficult to eliminate them [16].

Davenport et al., reported that the denture surface roughness could traumatise the oral tissues [17]. Williams DW and Lewis MA concluded that surface roughness was in favor of microorganism colonisation and caused indirect tissue damage [18].

Since various methods used to provide denture hygiene have been shown to affect the physical and mechanical properties of acrylic resins, this *in vitro* study was undertaken to investigate the effects of tablets and 2% NaOCl solution used to cleanse complete dentures in association with a tea solution on heat cured acrylic surface irregularities and colour changes.

Azevedo A et al., investigated the effect of 1% hypochlorite detergents and 4% chlorhexidine on surface roughness of acrylic resins and showed that disinfectant solutions do not have a significant effect on acrylics surface roughness, consistent with that, in this study hypochlorite and professional tabs had no significant effect on acrylics surface roughness [19]. On the other hand, Firouz F et al., showed that sodium 5.25% hypochlorite concentration significantly increases the level of surface roughness compared to lower concentrations [20]. However, surface roughness from sodium hypochlorite with lower concentrations was clinically acceptable. Da Silva FC et al., also studied the effect of disinfectant solutions on the surface of acrylic resins and showed that the hypochlorite solution could have some effect on the acrylic resin surface roughness [12]. Disinfectants in higher concentrations could have a softening effect on the matrix of acrylic resin and also cause the dissolution of free monomers and the decomposition of the matrix [11].

Comparison of the surface roughness of Acrosun acrylic resin and TDV dental acrylic resin under the effect of detergents showed that Acrosun acrylic resin is comparable to the TDV dental in terms of surface roughness changes.

Finally, regardless of the type of acrylic resin, group 6 samples exhibited the highest surface roughness, and group 1 exhibited the lowest value. Colour change (ΔE) evaluation in the study groups showed that the mean colour changes in group 4 (tea solution) were higher compared to the other groups, and in the control group, the changes were lower compared to the other groups. Therefore, individuals wearing dentures can decrease the consumption of these staining drinks and help stabilise the colour of dentures in the long term. Keskin S reported that staining drinks leave layers

on the surface of acrylic resin, which changes its colour [21]. Colour changes might also be due to the presence of pigmented particles in the porosities and surface irregularities of acrylic resins.

Comparison of groups 1, 2 with the control group showed that sodium hypochlorite could have a significant effect p-value <0.05* on colour change. Davi LR et al., examined the effect of immersion in several detergent solutions on the colour stability of acrylic resins [11]. They showed that the highest discolouration occurred in 1% NaOCl and reported that immersion in sodium hypochlorite solution for eight hours a day for 180 days had a definite effect on the colour stability of the denture, consistent with the current results. Peracini A et al., studied the colour change of acrylic resins after immersion in detergent solutions (corega tabs and bony plus) and reported that the colour changes were not significant clinically [8]. In the current study similar results were obtained (comparison of group 3 and control group was insignificant). Sato S et al., reported no colour change in acrylic resins immersed in detergent solutions (corega tabs, bony plus and efferdent plus) [22]. The result was similar to the present study (comparison of group 3 and control group was insignificant).

Examination and comparison of colour changes of Acrosun and TDV dental acrylic resins in tea solution (group 4) showed that the colour changes in Acrosun acrylic resin group were greater compared to TDV dental acrylic resin. However, the difference was not significant. This indicates that the rate of discolouration in both types of acrylic resin was the same.

The results showed that TDV dental acrylic resin exhibited more colour stability (less colour change) in NaOCl disinfectant solution (group 1, 2 and 5), and the difference was significant. However, the professional cleansing tablet solution had almost the same effect on both acrylic resins. Although the colour changes were less in TDV dental acrylic resin, it was not significantly different from Acrosun acrylic resin (group 3 and 6).

Limitation(s)

There were certain limitations in the present study like true simulation of oral conditions, composition and pH of saliva was not done and time period of the study was limited, denture cleansers may be used for much longer time.

CONCLUSION(S)

Acrylic resins exposed to tea exhibited more surface roughness compared to those not exposed to tea; therefore, it can be claimed that tea increases the surface roughness and colour change in acrylic resins. Acrosun (Betadent Co., Iran) and TDV dental (Brazil) acrylic resins did not exhibit a significant difference in surface roughness after the tests. However, TDV dental acrylic resin exhibited better colour stability. The results showed that NaOCl solution exhibited the highest potential to remove stains. The professional cleansing tablets were weaker in removing tea stains compared to NaOCl solution. The results showed that TDV dental acrylic resin exhibited more colour stability (less colour change) in NaOCl disinfectant solution. However, the professional cleansing tablet solution had almost the same effect on both acrylic resins.

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