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Original Article

Evaluation of Color Stability of Finix, Super Berelian and Betastar Acrylic Denture Teeth in Effect of Dentipur Denture Cleaner

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Abstract

Background: None of the previous studies have evaluated acrylic resin teeth used at the Dentistry Department of Hamadan University of Medical Sciences (brands: Finix, Super Berelian, and Betastar).

Methods: A total of 252 samples containing acrylic resin teeth used at Hamadan Dental School were studied. Finix, Super Berelian, and Betastar were selected in the same mold and in 3 colors. (A1, A2, A3). The samples of each brand were studied in 2 groups. The first group was placed in a solution of Dentipur cleaner for 7 days. The second group of specimens was placed in 100 mL of distilled water. Data were recorded in the CIELAB system, and the spectrophotometer obtained values of ΔE, ΔL, ΔH, and ΔC. Then, changes in each of the components were obtained before and after the intervention.

Results: The results show that the changes in the parameters of ΔE, ΔL and ΔC were statically significant when comparing the 2 groups ($P<0.05$) and only in terms of the parameter ΔH, the changes were not statically significant ($P>0.05$). The changes made in the variables were significantly different from the initial color of the samples in the factors ΔE, ΔL and ΔH ($P<0.001$) but in terms of the parameter ΔC, the changes were not statically significant ($P>0.001$), and the changes in the variables were significantly different from the sample brand in all the measured factors ($P<0.001$).

Conclusions: Dentipur denture cleaner creates more color change than distilled water in acrylic teeth. The changes in most variables were associated with the shade of acrylic teeth, and in the teeth with brighter shade, the color change was higher compared with a darker shade. Super Berelian teeth have the most color change and Betastar teeth showed the lowest change in color. Delta E value was clinically acceptable.

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Background

Denture or prosthetic teeth are produced in different generations and colors and are available in porcelain cooked in a vacuum, methacrylate resins, modified methacrylate resins, vinyl resins, and composite resins (1).

Methacrylate resin teeth are less wear-resistant than porcelain teeth, and they change color with organic colors. However, the abrasion resistance of these teeth has improved with the use of polymers and fillers such as silica filler (1).

Teeth made of composite resin show significantly less enamel wear than porcelain teeth. Additionally, the fillers in these teeth increase the strength of the teeth, which has led to the use of composite resin teeth as the most commonly used teeth in the design of single complete dentures (1).

Several studies have suggested that the color of the denture teeth is one of the important considerations of the treatment in denture patients (2,3).

Due to the increasing importance of the beauty and aesthetic aspects in dentures and dental prosthesis and the increasing expectations of patients from removable prostheses, the resistance of denture teeth to color change is their main reason for choosing them in prosthetic treatments (4).

Color stability is defined as the ability of the substance

Highlights

None of the previous studies have evaluated acrylic resin teeth used at the Department of Dentistry, Hamadan University of Medical Science. This study was conducted in this field and the main findings are:

- The Dentipur denture cleaner creates more color change than distilled water, in acrylic teeth.
- Changes in most variables were associated with the shade of acrylic teeth.
- Super Berelian teeth had the most color change and Betastar teeth showed the least change in color.

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to retain its color over time in a specific environment and some researchers associate it with the success or failure of the prosthesis in the field of beauty (4,5).

The etiology of color change in denture teeth is multifactorial and includes abrasion, poor patient hygiene, denture cleaner effects, external and internal color sources, and time (4).

One of the potential factors that can change the color of denture teeth is denture cleaners. Denture cleaning and disinfecting methods include mechanical brushing, ultrasonic devices, and microwave beam with various chemical cleaners (1).

Mechanical methods such as brushing can cause erosion of tooth and denture base and affect the beauty of them (6).

Chemical methods have several advantages such as full access to all denture areas, minimal damage, and antimicrobial effects and include denture cleaners, Denture dough, antimicrobial solutions, washing liquid and so on (6).

Denture cleaners can have effective compounds such as alkaline peroxide, hypochlorite, dilute acids and enzymes (1, 7). These materials are routinely used by denture users and their ease of use, especially in patients with impaired manual dexterity, is an advantage (8). An appropriate denture cleaner should have the following characteristics: non-toxic, antimicrobial, mass removal, cheap and long expiration time (1). However, there is no cleaner which has all the features. For example, several reports have been made on the unacceptable and discontinuous discoloration of resin teeth in long-term use of these materials (9, 10).

Various studies have been done to investigate the effect of denture cleaner on color changes in denture, especially in acrylic resin teeth (4,9,11-13). However, there is no study that has been done on acrylic resin teeth that are used at the Department of Prosthodontics, School of Dentistry, Hamadan. In addition, due to the development of denture cleaner and the production of new brands, the evaluation of these brands has not been made in terms of dental color changes.

For this reason, the subject of this study was to investigate the effect of a new and high-powered cleaner called Dentipur on acrylic denture teeth used at the Department of Prosthodontics, School of Dentistry, Hamedan, Iran (Finix, Super Berelian, and Betastar brands).

Methods

The most widely used resin acrylic teeth at the School of Dentistry (Department of Prosthodontics) in Hamadan, including Finix, Super Berelian, and Betastar, were selected in the same mold.

Since the concentration and color of the pigments vary in different dental shades, this difference can affect the response of the samples to the cleaner agent, as well as the similar method (4,6). In this study, 3 colors A1, A2, and A3 were selected for each of these brands.

In addition, in order to uniform the samples, maxillary right central incisors were selected from each group. In order to calculate the sample size, PASS software was used and the same paper was used to determine the sample size parameters. For this, one-way analysis of variance (ANOVA) with 3 levels with a maximum difference of 0.3 as the response variable (ΔE) (average of 4 groups, 0.9-1.2-1.5) was used. The standard deviation was 1.2 which was similar to the previous studies. The sample size was equal to 84 samples per commercial brand (and a total of 252 samples) with a power of 80% and a significance level of 0.05 (14, 15).

The samples of each brand were studied in 2 groups. The first group was placed in a solution of Dentipur tablets for 7 days (prepared according to the manufacturer's instructions to dissolve a tablet in 100 mL of 35°C water) in order to revive the active oxygen; the solution was replaced every day. The second group of specimens was placed in 100 mL of distilled water at 35°C for 7 days (4).

The initial color of the samples was evaluated and recorded by a spectrophotometer (VITA Easyshade® Advance 4.0, VITA Zahnfabrik H. Rauter GmbH & Co. KG, Germany).

First, a positioning jig was made to accurately position the facial surface of the samples under the probe of the device, which was 5 mm in diameter.

The jig was constructed as follows:

At first, an acrylic block was selected and then a concavity was made on its upper surface so that the depth and width of the concavity were equal to the largest dimensions of the tooth in these 3 dimensions.

Then, 4 column indexes were created on the upper surface with the same dimensions, so that the concavity was created in their center.

Then the inside of the concavity is filled with the polyvinyl siloxane (molding material). When the material is being polymerized, the tooth is placed inside the material so that the buccal surface is slightly higher than the acrylic block level. Then, an acrylic bar of 5 mm in diameter (using a spectrophotometer) was attached to the buccal surface of the tooth, and after that, a polyvinylsiloxane impression was made from the entire acrylic block surface, acrylic bar, the tooth surface, and 4 column indexes.

After polymerization, the impression material was replaced with acryl. In this way, we had 2 acrylic pieces that were detachable, and the teeth and probe of the device could be precisely positioned in a repeatable position (Figure 1) (4). Then, the data of the spectrophotometer unit was collected by one person: The control group before and after 7 days in distilled water and the second group before and after 7 days in a solution of washing agent.

Data were recorded in the CIELAB system and the values of ΔE, ΔL, ΔH, and ΔC were obtained by

the spectrophotometer. Then, changes in each of the components were obtained before and after the intervention (Figure 2) (16).

The threshold for visual changes was used in the data analysis. ΔE equal to 3.5 used as the threshold was clinically acceptable. Mean and the standard deviation was used to compare 3 variables of color change, type of tooth color (A1, A2, A3) and 2 types of dental brands (17).

After collecting data, data were analyzed using descriptive statistics. In addition, to compare the characteristics of the 2 groups, Student's *t* test and one-way ANOVA were used. SPSS software version 16.0 was used to analyze the data, and the significance level of the tests was considered 5%.

Results

The main findings of the study were descriptively shown in Tables 1, 2 and 3. Student's *t* test was used to compare the 2 groups; the results were summarized in Table 4.

Figure 1. Positioning Jig.

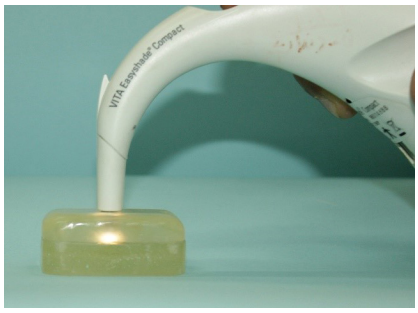

Figure 2. Data Collection by Spectrophotometer.

Table 1. The Results of the Comparison Between the 2 Study Groups

Variables	Groups	N	Mean	SD
DE	Water	126.00	-0.46	0.82
	Cleaner	126.00	-1.19	0.95
DC	Water	126.00	-0.92	0.53
	Cleaner	126.00	-1.28	1.16
DH	Water	126.00	0.83	1.12
	Cleaner	126.00	0.99	1.07
DL	Water	126.00	0.01	0.45
	Cleaner	126.00	0.76	1.20

The results show that the changes in the parameters of ΔE, ΔL and ΔC are statically significant ($P<0.05$) when comparing the 2 groups, but in terms of the parameter ΔH, the changes are not statically significant ($P>0.05$).

One-way ANOVA was also performed to evaluate the changes made in the variables by the primary color separation of the samples, and the results of which are shown in Table 5.

The results indicated that the changes made in the variables were significantly different in the initial color of the samples in the factors ΔE, ΔL and ΔH ($P<0.001$) but in terms of the parameter ΔC, the changes were not statically significant ($P>0.001$).

One-way ANOVA was also performed to evaluate the changes made in the variables by brand separation of the samples, and the results of which are written in Table 6.

The results indicated that the changes in the variables were significantly different from the sample brand in all the measured factors ($P<0.001$).

Table 2. The Results of the Primary Color Separation of the Samples

Variables	Shade	N	Mean	SD
DE	A1	84.00	-1.03	0.73
	A2	84.00	-0.92	0.93
	A3	84.00	-0.89	1.11
DC	A1	84.00	-0.89	0.66
	A2	84.00	-1.31	0.95
	A3	84.00	-1.10	1.05
DH	A1	84.00	1.49	0.86
	A2	84.00	0.90	1.34
	A3	84.00	0.70	0.66
DL	A1	84.00	0.33	0.67
	A2	84.00	0.39	0.51
	A3	84.00	0.12	1.39

Table 3. The Results of the Brand Separation of the Samples

Variables	Brand	N	Mean	SD
DE	Super Berelian	84.00	-1.14	1.26
	Betastar	84.00	-0.44	0.60
	Finix	84.00	-0.89	0.75
DC	Super Berelian	84.00	-2.02	0.87
	Betastar	84.00	-0.46	0.34
	Finix	84.00	-0.82	0.55
DH	Super Berelian	84.00	1.54	1.50
	Betastar	84.00	1.20	0.85
	Finix	84.00	0.99	0.66
DL	Super Berelian	84.00	0.80	1.34
	Betastar	84.00	0.36	0.53
	Finix	84.00	0.45	0.71

Table 4. The Results of Student's *t* test for the Comparison of the 2 Groups

Variables	T	Def	Sig. (2-tailed)
DE	6.58	250.00	<0.05
DC	3.25	250.00	<0.05
DH	-1.13	250.00	0.26
DL	-6.59	250.00	<0.05

Table 5. The Results of One-Way ANOVA for the Evaluation of the Changes in the Variables by the Primary Color Separation of the Samples

Variables		Sum of Squares	Mean Square	*F*	*P* Value
DE	Between groups	11.41	5.71	6.50	<0.001
	Within groups	218.51	0.88		
DC	Between groups	7.59	3.79	4.67	0.01
	Within groups	202.20	0.81		
DH	Between groups	57.17	28.58	28.96	<0.001
	Within groups	245.81	0.99		
DL	Between groups	21.79	10.89	12.39	<0.001
	Within groups	218.86	0.88		

Table 6. The Results of One-way ANOVA for the Evaluation of the Changes in the Variables by Brand Separation of the Samples

Variables		Sum of Squares	Mean Square	*F*	*P* Value
DE	Between groups	20.97	10.49	12.50	<0.001
	Within groups	208.95	0.84		
	Total	229.92			
DC	Between groups	112.44	56.22	143.80	<0.001
	Within groups	97.35	0.39		
	Total	209.79			
DH	Between groups	19.19	9.60	8.42	<0.001
	Within groups	283.78	1.14		
	Total	302.98			
DL	Between groups	26.81	13.41	15.61	<0.001
	Within groups	213.84	0.86		
	Total	240.65			

Discussion

The null hypothesis, which suggests that the denture cleaner does not have any effect on the color change of the samples, was rejected and the changes in variables were significant.

According to the results, the changes in most variables were significant and the changes in the denture cleaner group were higher. This indicates the detrimental effects of this cleanser on the color of the acrylic teeth, which has not been mentioned in the manufacturer's advertising and should be considered in patients who use it to clean their dentures.

The color instability of acrylic teeth against dentin cleanser has already been proven in some studies. In this regard, the present study is consistent with previous studies and showed that these teeth, even under the influence of distilled water, become discolored (6).

Comparing the 2 study groups, the changes in color were not meaningful, which can be attributed to the duration of the test, since color changes, which are equivalent to major changes in the color of the tooth, require time and are therefore suggested in subsequent studies.

Comparing the changes made in the variables with the primary color of the samples, in most variables, the greatest changes were observed in shade A1 and the least changes belonged to shade A3. This finding is in line with previous studies (2) and its possible cause is the effect of the concentration of pigments in the tooth. Therefore, in the teeth with brighter shade due to low pigment concentration, the color change is higher compared to a darker shade.

The color changes created in different commercial brands were significant and in all variables, the highest change was related to Super Berelian teeth. In addition, in most variables, Betastar teeth have shown the slightest change. These findings can be important in choosing these brands for clinical use.

Delta E measured in this study, which was measured directly by a spectrophotometer, was less than 3.5 for all samples and was clinically acceptable. This finding is in line with previous studies on this subject (2,5,6) probably due to the limited time of the study, laboratory conditions and type of data collection.

In this study, we used a spectrophotometer to evaluate Delta E without any formula. It is recommended that for further studies Delta E formula should be used by collecting a, b and L values with a spectrophotometer ($\Delta E = \sqrt{\Delta a^2 + \Delta b^2 + \Delta L^2}$).

For better results, it is also recommended that more time should be spent on future studies and they should be done in clinical situations.

Conclusions

Despite the limitations of the study, the following results are valid:

1. The Dentipur denture cleaner creates more color change than distilled water, in acrylic teeth.
2. Changes in most variables were associated with the shade of acrylic teeth, and the color change was higher in the teeth with a brighter shade compared with a darker shade.
3. Regarding the brand, Super Berelian teeth have the highest color change and Betastar teeth showed the least change in color.
4. Delta E value in all specimens was clinically acceptable.

Authors' Contribution

All authors have contributed to the concept and design of the

study. AS, BFA and AI supervised the conduct of the experiment. BFA contributed to the data collection. The statistical analyses and interpretation of data were carried out by GR. SKH, BFA and SA drafted the manuscript. All the authors critically revised the manuscript for intellectual content. All the authors have read and approved the final manuscript.

Ethical Statement

The study was approved by the ethical committee of Hamadan University of Medical Sciences.

Conflict of Interest Disclosures

The authors declare that they have no conflict of interests.

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