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Effect of Anti-erosion Toothpasteson Color Stability of Different Restorative Materials

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ABSTRACT:
Objective: The purpose of this study was to evaluate the effects of anti-erosion toothpastes on the color stability of three different restorative materials: Resin composite, conventional glass ionomer and resin modified glass ionomer.
Methods: Sixty cylindrical specimens were prepared from each material and the initial reading of color(T1) was recorded after finishing and polishing. Each material was randomly divided into 4 groups according to the anti-erosion toothpastes or water as control. Application of the anti-erosion toothpastes or water was performed by brushing using electric toothbrush for one hour, which is equivalent to brushing for two minutes twice each day for 15 days and the color(T2) was recorded.The color was measured 3 time in the center of each specimen using a spectrophotometer against a white background.
Result: Filtek Z250 XT showed the highest color change values ΔE* (Mean$\pm$ SD) after finishing and polishing 4.280 $\pm$ 7.400 and lowest 0.979 $\pm$ 0.669. Filtek Z250 XT also showed the highest color change values ΔE* after application of Sensodyne Pronamel1.307 $\pm$ .786 and lowest application of Regenrate 0.651 $\pm$ 0.307. Color change values ΔE* of resin composite (Filtek Z250 XT) after exposure to Sensodyne Pronamel showed significant color changes (P<0.002). In addition, color change values ΔE* of glass ionomer cement (Ketac Fil Plus Aplicap) after exposure to Regenerate showed significant color changes (P<0.005).
Conclusion: Color change values ΔE* of Filtek Z250 XT after application o Sensodyne Pronamel and Ketac Fil Plus Aplicap after application of Regenerate showed significant color changes. Short-term brushing for one hour with anti-erosion toothpastes resulted in non-significant changes of the color of Fuji II LC as well as majority of Filtek Z250 XT and Ketak Fil Plus Aplicap, which indicates their excellent color stability mostly not depending on the anti-erosion toothpastes.

Keywords: Anti-Erosion Toothpastes, Resin-Based Composite, Color Stability, Dental Erosion, *In Vitro*

I. INTRODUCTION

Currently the restorative materials have been improved to match the patients' esthetic desires and dentists prefer to use tooth colored restorative materials compared to non-esthetic restorative materials such as amalgam.[1]An esthetic restorative material comes with different physical properties and shades.[2]Presently, resin composite, glass ionomer cement, and resin-modified glass-ionomer cement are the most popular used direct esthetic materials.[2]Resin composite and resin-modified glass-ionomer cement are commonly used compare toglass ionomer cement due to their improvement in the mechanical properties, esthetic, and bonding.[3,4]Many authors claimed that the lack of use of glass ionomer cements as direct esthetic restoration is their poor abrasion and fracture resistance.[5,6]

Some investigations reported that the color of esthetic direct restorative materials might change due to exposure to physical-chemical conditions, which is considered a major causefor replacement of restorations.[7,8] Moreover, discoloration in restorative materials is multifactorial and it can be either intrinsic or extrinsic induced discoloration.[9,10] Resin matrix, filler loading, and photoinitiator systems have a direct impact on intrinsic color stability.[11]Such materials are susceptible to extrinsic staining; including plaque accumulation, superficial degradation, and surface stains due to adsorption of staining agents such as different drinks, beverages, and whitening toothpastes.[12,13]

Dental erosion is permanent loss of the hard dental structures chemically without the association of the microorganisms.[14] This mineral loss result in demineralized surface and reduced microhardness.[15] The process may be associated with an intrinsic factor, i.e. gastric acid; or it may be caused by extrinsic factors related to dietary habits and lifestyle.[14]Some anti-erosion toothpaste is available in the market such as Sensodyne Pronamel.[16] Sensodyne Pronamel is a derivative of Sensodyne toothpaste with greater levels of bioavailable fluoride and potassium nitrate (5% w/w) and was suggested as effective in preventing erosion of permanent teeth.[16]The important function of dentifrices has become more specialized during the recent years, some dentifrices containing therapeutic agent that could help to reduce plaque, calculus and reduced sensitivity.[17]Some dentifrices concern more about cosmetic effect, which contain chemical and mechanical agent to remove staining.[17]Many dentifrices formulation contain abrasive particle such as silica, calcium carbonate that have effect on surface characteristics of dental restorative material that might cause changes such as roughness of the surface.[17]

As far as the authors are aware, little information is known regarding the effect of anti-erosion toothpastes on color stability of restorative materials. Therefore, the purpose of this investigation was to assess the effects of three anti-erosion toothpastes (Sensodyne Pronamel, Biorepair and Regenerate) on color stability of three restorative materials:Resin composite (Filtek Z250 XT), glass ionomer cement (Ketac Fil Plus Aplicap), and resin modified glass ionomer cement (GC Fuji II LC). The null hypothesis was there is no difference in the effects of the anti-erosion toothpastes tested on color stability of the tested restorative materials.

II. MATERIALS AND METHODS

The Ethical Committee of Human Studies, College of Dentistry Research Center, King Saud University, approved this study. The three anti-erosion toothpastes and the three restorative materials used in this study and their manufacturers are listed in Table 1. The power sample size was 0.83 and level of significant σ=0.05 with estimated standard deviation =0.8, the sample size should be at least 15 in each group. A total of 60 cylindrical specimens prepared for color evaluations from each restorative material according to the instructions of the manufacturer using standard mold of 10mm diameter and 2mm thickness. The materials compressed within the mold, covered by a Mylar strip (Myltrip, Dental Mylar Strips, Dent America Inc., City of Industry, CA, USA), and a microscopic glass slide (Shandon™ Polysine Slides, Thermo Scientific, Kalamazoo, MI, USA) to press the material flat even with the surface of the mold. Each specimen of Filtek Z250XT and GC Fuji II was light cured for 20 seconds using an LED curing light (Elipar S10, 3M ESPE, Seefeld, Germany). The bottom of the cylindrical specimen was also light cured for 20 seconds. Similar specimens were fabricated using Ketac Fil Plus Aplicap according to the instructions of the manufacturer. The bottom surface of the cylindrical specimen was marked to identify the bottom surface. This allowed avoidance of error in measuring color of the bottom surface and also not using this surface to touch the anti-erosion toothpastes. All specimens prepared at room temperature (approximately 25^{o}C). The specimens removed from the mold, checked for evident irregularities. All specimens were finished for 15 seconds at 30.000 rpm using Sof-Lex (3M ESPE, St. Paul, MN, USA) finishing and polishing discs according to the instructions of the manufacturer. Then polished for 15 seconds at 30.000 rpm. The specimens from each material were randomly divided into 4 groups of 15 each according to the different anti-erosion toothpastes used and distilled water was used as control. All specimens were stored in distilled water (pH 6.8) at room temperature for 24 hours.Baseline measurements of color were recorded (Testing Phase One - T1). Table 2 shows distribution of different groups according to the materials used.

All specimens were brushed manually with water without anti-erosion toothpastes (control) or brushed manually with the different anti-erosion toothpastes for one hour, which is equivalent to brushing for two minutes twice each day for 15 days. Each specimen was brushed using electrical toothbrush with power of 1.7W and frequency 50, 60 Hz (Oral B, Braun GmbH, frankfurter Kronberg\Ts. Germany). To standardize the force of brushing, the electric toothbrush was placed in a created mold to stabilize/hold the brush in the same position during brushing and water (5 drops) or different anti-erosion toothpastes (250 mg) were added to each specimen every 10 minutes. The specimens were then rinsed using distilled water for five minutes and blotted dry with tissue paper before measurements of color (Testing Phase Two - T2).The color was measured 3 time in the center of each specimen using a spectrophotometer (Color-Eye 7000, NY, USA) against a white background using LABCH relative to CIE standard illuminants D65, CWF and C to measure ΔE (color difference) for SCI (Specular Component Included).

Statistical analyses was performed using two-way repeated measures ANOVA where materials and anti-erosion toothpastes as two factors and pre- and post- results as repeated measures then follow by one-way ANOVA and paired t-test. All statistical analyses was set at a significance level of $p<0.05$. The statistical analysis was carried out with SPSS V16.0(Statistical Package for the Social Sciences, SPSS, Chicago, Illinois, USA).

III. RESULT

Table 3 shows mean and std. deviation of the color change values ΔE* for the three restorative materials after finishing and polishing and exposure to the three anti-erosion toothpastes.When discoloration of different materials is considered, Filtek Z250 XT showed the highest color change values ΔE* (Mean± SD) after finishing and polishing 4.280 ± 7.400 and lowest 0.979 ± 0.669.Filtek Z250 XT showed the highest color change values ΔE* after application ofSensodyne Pronamel 1.307 ± .786 and lowest application of Regenrate 0.651±0.307. Fuji II LC showed the highest color change values ΔE* after finishing and polishing 3.130 ± 2.949 and lowest 2.216 ± 1.255 while the highest color change values ΔE* was after application of Biorepair 3.344 ± 1.904 and lowest application of Sensodyne Pronamel 1.857 ± 1.134. Ketak Fil Plus Aplicap showed the highest color change values ΔE* after finishing and polishing 5.399 ± 2.940 and lowest 1.856 ± 1.761 while the highest color change values ΔE* was after application of Sensodyne Pronamel 2.919 ± 1.627 and lowest application of Biorepair 1.912 ± 1.961.

Mean and std. error of the color change values ΔE* for Filtek Z250 XT, GC Fuji II LC, and Ketak Fil Plus Aplicap after finishing and polishing and exposure to the three anti-erosion toothpastes are presented in Tables 4-6.Majority of the groups showed non-significant differences between color change values ΔE*after finishing and polishing and after exposure to the anti-erosion toothpastes.Color change values ΔE* of resin composite (Filtek Z250 XT) after exposure to SensodynePronamelshowedsignificant color changes (P<0.002). In addition, color change values ΔE* of glass ionomer cement (Ketac Fil Plus Aplicap) after exposure to Regenerate showed significant color changes (P<0.005).

IV. DISCUSSION

The null hypothesis was partially rejected, as there was effect of some anti-erosion toothpastes tested on color stability of the two of the tooth-colored restorative materials tested (Filtek Z250 XT and Ketac Fil Plus Aplicap). The dental restorative material could have irregular surface characteristics that might increase plaque retention and these affect esthetic and physical properties of the dental restorative materials. For this reason, clinician tend to create smooth and polish surface.[18] So adequate finishing and polishing of dental material give good result on esthetic aspect and reduce the plaque accumulation and extrinsic staining.[19] There are many factors influence tooth roughness such as prophylaxis procedure and tooth brushing with toothpaste, which alter the quality of the surface of the restorative material.[18]In the present study, color change values ΔE* of Filtek Z250 XT after application of Sensodyne Pronamel and Ketac Fil Plus Aplicap after application of Regenerate showed significant color changes ΔE*. Another study using same materials reported that the most toothpaste caused change on surface roughness on Filtek Z250XT was Sensodyne Pronamel and for the CG Fuji II LC and Ketak Fil Plus Aplicap was Biorepair.[20]The key aim of effective elements against erosion is to intensify the resistance of tooth surfaces or pellicles to acid.[15,21] The effective elements may be lessened by the abrasives in the toothpastes, which is valuable in cleanin.[15] Fluoride containing toothpastes provide part of defense but effective elements should be added in addition to, or other than, fluorides.[15]

A study investigated new toothpastes with anti-erosion properties reported that tin-containing gel reduced the erosive tissue loss 75%.[21]Another study used fluoride to inhibit demineralization of enamel caused by citric acid and to promote repair concluded that the value of fluoride is outweighed by the influence of NaHMP as a mineralization inhibitor.[22] Also, a study evaluated *in vitro* the efficacy of anti-erosion desensitizing toothpaste to inhibit enamel surface softening showed that treatment with fluoride-containing toothpastes helps protect sound enamel from acid-mediated surface softening and promotes re-hardening of erosive lesions.[23]Furthermore, a study investigated the erosion/abrasion-preventing potential of experimental amine fluoride toothpastes showed that the formulations have the potential to reduce erosion/abrasion even in the absence of demineralized collagen.[24]

Surface roughness of different restorative materials governs the quality, color and performance of materials in the oral cavity.[25] Roughness could also worsen buildup of plaque and diminish longevity and esthetics of the restorations.[25]Experimental data demonstrated that high surface roughness of restorative materials is correlated to presence of more biofilm on its surface.[26] The aim is to produce restorations with smooth surfaces without irregularities which result in improved esthetics and minimal plaque accumulation.[27,28]

The color values of resin composite used in this study can be explained by material filler composition. This material is a submicronhybrid resin composite, filled with nanometer size particles, from which some are dispersed and others create nanoclusters, as secondary formed fillers.[29] The size of these nanoclusters can range from about 0.6 to 10 μm.[29]Mylar strips and celluloid crowns are usually applied as matrices for shaping restorative materials, which more likely require no further surface finishing.[26] It was suggested using polyester strips against resin composite to produce the best smooth surface.[26]However, in the present study we performed finishing and polishing to simulate clinical situations where application of Mylar strips is not possible as in case of occlusal restorations. A study reported significantly higher surface roughness for polished resin composite compared to the one polymerized against Mylar strips.[30]Studies have investigated different polishing methods on surface roughness and many have reported that none of these methods could mimic the surface smoothness initially created by a Mylar strip.[31,32] However, another study observed this phenomenon only for one resin composite material, whereas other resin composites showed no significant differences in surface roughness between the surfaces polished with silicone carbide paper and those polymerized against Mylar strips.[27,32]

During tooth brushing, the toothpaste is quickly diluted by saliva. In the present study, the toothpastes were not diluted prior to application according to the manufacturers' directions. A study investigated the influence of two anti-erosive toothpastes(Pronamel & Tooth Mousse) on surface roughness of five restorative materials concluded that neither of the of two anti-erosive toothpastes caused a significant change on the surface roughness of tested restorative materials except the conventional glass ionomer restorative material Ionofil U.[18]The present study showed that short-term brushing for one hour with anti-erosion toothpastes resulted in non-significant changes of the color of Fuji II LC as well as majority of Filtek Z250 XT and Ketak Fil Plus Aplicap which indicates their excellent color stability mostly not depending on the anti-erosion toothpastes. Similar study of the surface roughness of Filtek Z250 XT and Fuji II LC reportedincrease of surface roughness after finishing and polishing with Sof-Lex system compared to the baseline measurement.[20]This may be attributed to finishing and polishing of the restorative materials, which may be challenging because particles and matrix differ in hardness and thus cannot be abraded uniformly.[33] Effective finishing instruments should have cutting particles harder than the filler materials. If not the polishing instrument will only remove the matrix and leave the particles protruding from the surface, which result in a rougher surface. In general, a statically significant difference on surface roughness after brushing with water or different anti-erosion toothpaste was recorded in another study.[20] It was also reported that the lowest surface roughness reading after brushing the Filtek Z250 XT was recorded when the specimens were brushed with water then Regenerate and Biorepair while the highest surface roughness was with Sensodyne Pronamel.[20] Regarding Fuji II LC the lowest values of surface roughness was recorded after brushing with Regenerate toothpaste then water and Sensodyne Pronamelrespectively while the highest surface roughness was recorded when brushed with Biorepair toothpaste.[20]For the Ketac Fil Plus Aplicap, Regenerate toothpaste has the lowest effect on surface roughness then Sensodyne Pronamel, water respectively while Biorepair toothpaste caused the highest increased the surface roughness.[20]The composition of the toothpaste has a crucial rule in the alteration of the surface roughness of dental restorative materials.[34] An investigation reported that the higher the relative dentin abrasivity of toothpaste the higher the surface roughness and wear of the dental materials.[34]Another factor which has a rule in increasing the surface roughness is the type of the toothbrush and pressure used when brushing.[34]

A spectrophotometer is used to measure color stability and resistance to staining effects which could be due to tea, coffee and juice and lower values indicate less staining.[35,36] A study was considered deltaE*ab< or =1 to be the limit of perceptibility and reported the difference in color among different resin composites and polishing systems used ranged from 0.2 to 1.1.[37]The present study showed that the color change values ΔE^* ranged between 0.98 and 4.28 and was recorded for Filtek Z250 XT. A study reported that color change values equal or greater than 3.7 indicated visually perceptible and clinically unacceptable.[38]Another study reported that when the specimens of each material was finished and polished affect surface smoothness and could be related to early discoloration as rough surfaces collect surface stains more than smooth surfaces cured against Mylar strip.[39,40]It is well known that the use of matrix strips will produce the smoothest composite surface because of the resin rich layer at the surface.[41]Staining is greatly affected by filler composition and composite monomer.[41]Urethane dimethacrylate (UDMA) appears to have higher stain resistant than bis-GMA.[42]Since all examined materials namely resin composite (Filtek Z250 XT), conventional glass ionomer (Ketac Fil Plus Aplicap), and resin modified glass ionomer (GC Fuji II LC) have different composition, they are not equally susceptible to surface staining and change of color. This explains the significant differences observed between these materials in this investigation. This investigation found that some tested materials displayed color difference after exposure to some anti-erosion toothpastes.

Color change and color instability of restorative materials over time are due to oxidation of surface pigments and amine compounds.[43] In addition, differences in color change might be due to dissimilarity of the amount of resin and different degrees of conversion of the resin matrix to polymer.[44,45] A study evaluated the color of restorative materials after exposure to Cola reported significant changes in color of the resin modified glass ionomer in all shades and in compomers and resin composites in the darkest shade.[46]Another study evaluated color stability of a compomer, a resin modified glass ionomer and a conventional glass ionomer when exposed to pH variations concluded no significant color changes.[47]

Some researchers observed that water sorption was closely related to stain sorption, thus, hydrophobic materials such as resin composite were more stain resistant than hydrophilic materials.[48,49]Previous studies observed that the resin matrix play a critical role in staining susceptibility.[11,13,35,41] Filtek Z250 consist of three major resin components: bis-GMA, UDMA, and bis-EMA. Many researchers observed that UDMA is more stain resistant than bis-GMA, thus the stain resistance of Filtek Z250 might be due to their low water sorption rate.[13,50]This is in consistent with our study results which also showed that the resin composite has a lower ΔE

values, which revealed that the resin composite was more stain-resistant than conventional glass ionomer and resin modified glass ionomer. A study reported that resin modified glass ionomer have higher stainability than conventional glass ionomer due to their rapid water sorption by HEMA, a significant resin component and their hydrophilic nature.[6,51] The explanation could be due to desiccation of conventional glass ionomer during setting causing interface microcracks.[20]

One of the limitations of this study was the use of only three restorative materials and three anti-erosion toothpastes. It would be beneficial if more and different restorative materials are tested. In addition, despite the *in vitro* nature of this study, it is sometime difficult to standardize all procedures. In addition, the specimen surfaces were flat, while, clinically, restorations have an irregular surfaces. Moreover, the clinical condition in the mouth is not easy to mimic in the laboratory.[52]However, in this *in vitro* study, standardization of experimental conditions was advantage and the results demonstrated a clear correlation between color stability of the tested restorative materials and anti-erosion toothpastes. In addition, color change is affected by aging, abrasion and thermocycling,[53]that were not considered in this study. In addition,*in vitro* setting may not simulate cumulative long-term effect of anti-erosion toothpastes *in vivo*. This may be different if we used the tested anti-erosion toothpastes for longer number of hours and repeated the use every day.

V. CONCLUSIONS

Under the experimental conditions of this *in vitro* study, we concluded that:

1) Majority of the groups showed non-significant differences between color change values ΔE* after finishing and polishing and after exposure to the anti-erosion toothpastes.
2) Color change values ΔE* of Filtek Z250 XT after application oSensodyne Pronamel and Ketac Fil Plus Aplicap after application ofRegenerate showed significant color changes ΔE*.
3) Short-term brushing for one hour with anti-erosion toothpastes resulted in non-significant changes of the color of Fuji II LC as well as majority of Filtek Z250 XT and Ketak Fil Plus Aplicap, which indicates their excellent color stability mostly not depending on the anti-erosion toothpastes.
4) Color stability varied depending on the anti-erosion toothpastes and the restorative material used and it is best for Fuji II LC.

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Table 1. Different anti-erosion toothpastes and the restorative materials used in this study

Restorative Material	Material, Manufacture Information, and Lot #	Anti-erosion Manufacture Information, and Lot #
Resin Composite (Filtek Z250 XT)	Filtek Z250 XT(3M ESPE, St. Paul, MN, USA)N624367	Sensodyne Pronamel - Glaxo Smith Kline Company 41522KWA
Resin Modified Glass ionomer (GC Fuji II LC)	GC Fuji II LCGC Corporation Tokyo, Japan 150303A	Biorepair - Coswell, Spa 40050 Funo/Italy 413751014
Conventional Glass ionomer (Ketac Fil Plus Aplicap)	Ketac Fil Plus Aplicap(3M ESPE, St. Paul, MN, USA) 520043	Regenerate - PT Unilever Indonesia tbk. Rungkut Industry IV/5-11 42038CA

Table 2. Distribution of different groups according to materials used

Restorative Material	Different Anti-erosion/Distilled Water	No. of Specimens
Filtek Z250 XT	Distilled Water	15
	Sensodyne Pronamel	15
	Biorepair	15
	Regenerate	15
GC Fuji II LC	Distilled Water	15
	Sensodyne Pronamel	15
	Biorepair	15
	Regenerate	15
Ketac Fil Plus Aplicap	Distilled Water	15
	Sensodyne Pronamel	15
	Biorepair	15
	Regenerate	15

Table 3. Mean and std. deviation of the color change values ΔE* for the three restorative materials after finishing and polishing and exposure to the three anti-erosion toothpastes

Restorative Material	Surface Treatment (Anti-erosion toothpastes and water)	Color stability after finishing and polishing		Color stability after toothpaste application	
		Mean	Std. Deviation	Mean	Std. Deviation
Filtek Z250 XT	Water	1.01	0.73	0.85	0.29
	Sensodyne Pronamel	4.02	2.77	1.31	0.79
	Biorepair	4.28	7.40	1.10	0.71
	Regenrate	0.98	0.67	0.65	0.31
Fuji II LC	Water	2.58	1.84	2.21	1.12
	Sensodyne Pronamel	2.22	1.26	1.86	1.13
	Biorepair	3.13	2.95	3.34	1.90
	Regenrate	3.13	2.95	2.89	1.46
Ketac Fil Plus Aplicap	Water	1.86	1.76	3.20	1.46
	Sensodyne Pronamel	2.28	1.10	2.92	1.63
	Biorepair	1.96	0.77	1.91	1.96
	Regenrate	5.40	2.94	2.28	1.24

Table4. Mean and std. error of the color change values ΔE* for Filtek Z250 XT after finishing and polishing and exposure to the three anti-erosion toothpastes

Surface Treatment (Anti-erosion toothpastes and water)	Timing*	Mean	Std. Error	95% Confidence Interval		*p*-value
				Lower Bound	Upper Bound	
Water	1	1.01	0.75	-0.48	2.50	0.542***
	2	0.85	0.33	0.20	1.51	
Sensodyne Pronamel	1	4.02	0.75	2.54	5.51	0.002**
	2	1.31	0.33	0.65	1.96	
Biorepair	1	4.28	0.75	2.79	5.77	0.118***
	2	1.10	0.33	0.45	1.75	
Regenrate	1	0.98	0.75	-0.51	2.47	0.109***
	2	0.65	0.33	0.001	1.30	

* 1- Color stability after finishing and polishing
* 2- Color stability after toothpaste application
** Significant $p<0.05$
*** Non-Significant $p>0.05$

Table5. Mean and std. error of the color change values ΔE* for GC Fuji II LC after finishing and polishing and exposure to the three anti-erosion toothpastes

Surface Treatment (Anti-erosion toothpastes and water)	Timing*	Mean	Std. Error	95% Confidence Interval		*p*-value
				Lower Bound	Upper Bound	
Water	1	2.58	0.75	1.10	4.07	0.576***
	2	2.21	0.33	1.56	2.87	
Sensodyne Pronamel	1	2.22	0.75	0.73	3.70	0.515***
	2	1.86	0.33	1.20	2.51	
Biorepair	1	3.13	0.75	1.64	4.62	0.764***
	2	3.34	0.33	2.69	4.00	
Regenrate	1	3.13	0.75	1.64	4.61	0.769***
	2	2.89	0.33	2.24	3.54	

* 1- Color stability after finishing and polishing
* 2- Color stability after toothpaste application
*** Non-Significant $p>0.05$

Table6. Mean and std. error of the color change values ΔE* for Ketak Fil Plus Aplicapafter finishing and polishing and exposure to the three anti-erosion toothpastes

Surface Treatment (Anti-erosion toothpastes and water)	Timing*	Mean	Std. Error	95% Confidence Interval		*p*-value
				Lower Bound	Upper Bound	
Water	1	1.86	0.75	0.37	3.34	0.045**
	2	3.20	0.33	2.55	3.86	
Sensodyne Pronamel	1	2.28	0.75	0.80	3.77	0.291***
	2	2.92	0.33	2.27	3.57	
Biorepair	1	1.96	0.75	0.47	3.45	0.926***
	2	1.91	0.33	1.26	2.57	
Regenrate	1	5.40	0.75	3.91	6.89	0.005**
	2	2.28	0.33	1.63	2.94	

* 1- Color stability after finishing and polishing
* 2- Color stability after toothpaste application
** Significant $p<0.05$
*** Non-Significant $p>0.05$

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