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Effect of Aging of Composite Tube on Color Change of Composite Resin

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Abstract: Background: This study aimed to assess the effect of aging of composite tube on color change of composite resins.
Materials and Methods: This in vitro, experimental study evaluated Enamel and Dentin composite types of 3M-Z350XT, Bisco-Aelite-aesthetic and GC-Essentia. Composite discs (n=6) measuring 1 x 8 mm were fabricated using newly opened composite tubes. The color of composite discs was measured by Easy Shade spectrophotometer according to the CIELab color space. Next, the composite tubes underwent accelerated aging according to the Arrhenius model and were incubated at 37°C in dry environment for 12 weeks. Composite discs with the same dimensions were fabricated again and their color was measured as before. Data were analyzed using SPSS.
Results: The change in a* and b* parameters was significant in all groups except for the Z350XT-Enamel (P=0.15). In the a* axis, the color of Aelite-Enamel shifted to green and the color of Aelite-Dentin, Essentia-Enamel, Essentia-Dentin and Z350XT-Dentin shifted to red. In the b* axis, the color of Z350XT-Dentin, Essentia-Enamel, Essentia-Dentin and Aelite-Dentin shifted to blue while the color of Aelite-Enamel shifted to yellow. In the L* axis, the changes in Aelite-Dentin, Aelite-Enamel and Essentia-Enamel were not significant but the changes in other composites were significant. The L* parameter increased in these three groups and they became lighter.
Conclusions: Aging of composite tube affects the color change of composite resins; thus, care must be taken when using aged composite tubes.

Keywords: Aging, Arrhenius Model, Composite Resins, Easy Shade.

1. INTRODUCTION

Operative dentistry is a combination of art and science. The success of restorative treatments depends on achieving optimal esthetics and function. Four parameters are imperative to achieve optimally esthetic restorations namely position, contour, surface topography, and color. (1)

Due to advances in composite resin formulations and their improved physical and chemical properties, their application is on the rise. (2) Moreover, composite resins are the restorative material of choice for direct restorations due to optimal esthetics, conservative cavity preparation, durability, and cost-effectiveness. (3)

Optimal color match with natural teeth, and preserving the surface texture and characteristics over time are important factors affecting the acceptance of tooth-colored restorations. Cosmetic dental restorations aim to mimic the shape, appearance and biological properties of enamel and dentin while providing an optimal color match with the adjacent natural teeth. Although composite resins have favorable clinical behavior and adaptation with the tooth structure, achieving a favorable color match is still challenging. (4, 5)

Introduction of a new or modified product to the market requires the manufacturer to guarantee the adequate shelf-life of the product for a certain time period with no compromise in safety and efficacy. (6) Shelf-life refers to the optimal period of safe and efficacious use of a product. Expiration date refers to a date after which, the product loses part of its primary efficacy. Several factors need to be considered with regard to the shelf-life and expiration date of a product. For this purpose, the product needs to undergo several analyses to assess its susceptibility to degradation, loss of efficacy, and failure threshold. (7)

The time passed since the production date of a composite tube may affect the color and esthetic properties of the final direct restoration. A recent study on the change of properties of aged composites showed that the majority of physical properties of composites as well as their resistance and stability changed due to aging. (8) However, no study has evaluated the possible change in optical properties of aged composites.

The accelerated aging protocols can be used to increase the level of stress applied to a dental instrument or material such as composite resins in order to obtain experimental data and assess the function and stability of the material after aging. (6) Although it may not be possible to easily access naturally aged composite tubes, it has been claimed that accelerated aging protocols may not be suitable for testing of new products either because sufficient data are not available about them. Nonetheless, these protocols can be used to obtain experimental data and simulate conditions such as high temperature and moisture. (9) According to Clark, the accelerated aging protocol can be calculated using the formula $r=Q10^{[(RT-ET)/10]}$ where r is the ratio of accelerated aging, RT is the room temperature (22°C), ET is the increased temperature, and Q10 is the coefficient of reaction ratio. Accordingly, per each 10° increase in temperature relative to the room temperature, the reaction ratio is doubled. (9)

The effects of aging on flexural modulus, flexural strength, thermal conductivity, weight loss, surface topography, (8) crystallinity, and spin concentration (of magnetic properties) of composites have been previously studied. (10) A previous study showed changes in surface topography, mechanical characteristics and thermal conductivity of the composite specimens that underwent accelerated aging (by Arrhenius). Also, their flexural strength increased. (8) Moreover, another study demonstrated that in some composite specimens, the center of rotation could severely increase after the expiration date, and the maximum amount of organic matrix and amorphous silica could be influenced by aging as well. (10)

Correct selection of restorative materials is a fundamental principle in cosmetic dentistry, and optimal esthetics can only be achieved by proper selection of material and technique. (11) The results obtained from this study can enhance the knowledge of dental clinicians regarding the effect of aging of composite tube on color change of composite restorations. Also, to the best of the authors' knowledge, no previous study has assessed the effect of aging of composite tube based on the type of composite (enamel and dentin) on color change of composite restorations. Thus, this study was undertaken aiming to assess the effect of in vitro simulated aging of composite tube on color change of enamel and dentin composite resins (3M-Z350XT, Bisco-Aelite aesthetic, Essentia GC).

First null hypothesis: Aging of composite tube would have no significant effect on the color parameters of composite.

Second null hypothesis: Type of composite (enamel or dentin) would have no significant effect on color parameters of composite.

Table 1 presents the characteristics of composite resins used in this study.

Table 1: Characteristics of composite resins used in this study

Composite brand	Composite type	Filler type	Filler size	Weight percentage of filler	Organic matrix
Bisco Aelite Aesthetic Enamel	Nanohybrid	Glass filler Amorphous silica	0.04–5.0 µ	73	Bis-GMA Bis-EMA
Bisco Aelite All-purpose Body	Microhybrid	Glass filler Amorphous silica	0.04–5.0 µ	76	Bis-EMA Bis-GMA TEGDMA
3M Filtek Z350 XT Enamel	Nano fill	Non aggregated silica and zirconia fillers and aggregated silica-zirconia fillers	Silica: 20 nm Zirconia:4–11 nm Cluster fillers (0.6 to 10 µ)	78.5	Bis-GMA TEGDMA PEGDMA Bis-EMA UDMA
3M Filtek Z350 XT Dentin	Nano fill	Non aggregated silica and zirconia fillers and aggregated silica-zirconia fillers	Silica: 20 nm Zirconia:4-11 nm Cluster fillers (0.6 to 10 µ)	78.5	Bis-GMA TEGDMA PEGDMA Bis-EMA UDMA
GC Essentia Enamel	Nanohybrid	Prepolymerized fillers, barium glass, fumed silica	Not found	81	UDMA, BisMEPP Bis-EMA Bis-GMA TEGDMA
GC Essentia Dentin	Microhybrid	Prepolymerized fillers, barium glass, fumed silica	Not found	76	UDMA, BisMEPP Bis-EMA Bis-GMA TEGDMA

2. MATERIALS AND METHODS

This in vitro, experimental study evaluated Enamel and Dentin types of 3M Z350XT, Bisco Aelite aesthetic and GC Essentia composite resins. Six discs were fabricated of each of the Enamel and Dentin types of the three composite brands. The composite tubes had about 2 years until their expiration date. The composite discs measured 8 mm in diameter and 1 mm in thickness. Plexiglass cylindrical molds with 8 mm diameter and 1 mm height were used for the fabrication of composite discs. Two celluloid strips were placed at the bottom and on top of the specimens. Next, the mold containing composite was compressed between two glass slabs and a 500 g weight was placed over it for 30 seconds in order for the excess composite to leak out. The specimens were then light-cured by a LED 50N cordless light-curing unit (TPC Advanced USA Technology, Inc.) for 60 seconds from the top and bottom according to the manufacturer's instructions. The power of the light-curing unit was 1000-1100 mW/cm^2. The specimens were then stored in distilled water and incubated for 24 hours to allow completion of polymerization.

For colorimetry of the composite discs, the Vita Easy Shade spectrophotometer (VITA Zahnfabrik H; Rauter GmbH & Co. KG, Germany) was used in a well sun-lit room with several windows at the midday. The color parameters of each disc were measured in triplicate, and the measured values were tabulated in Excel software.

Data were analyzed according to the CIE Lab color space where color is defined using the three parameters of L*, a* and b*. The L* indicates lightness while the a* and b* indicate the chromatic components of color. The color change or color difference in the CIE L*a*b* system is shown by delta E (ΔE).

In order to minimize the effect of environmental light, all color measurements were made at 10 A.M. to 12 P.M. by the same technician. The probe tip of the Easy Shade spectrophotometer was positioned perpendicular to the disc surface. Also, a white paper was placed in the background in order to prevent the confounding effect of background color on color measurements. The spectrophotometer was calibrated after each 5 times of measurement. For calibration, the hand-piece tip was positioned on the calibration sheet placed on a stub such that it was completely perpendicular to it and the calibration button was pressed. After three short beeps, the device was ready for use again.

Next, composite tubes were subjected to accelerated aging by incubation at 37°C under dry conditions for 12 weeks according to the accelerated aging model by Arrhenius. According to Clark, the accelerated aging protocol can be calculated using the formula $r=Q10(^{(RT-ET)/10)}$ where r is the ratio of accelerated aging, RT is the room temperature (22°C), ET is the increased temperature and Q10 is the ratio of reaction per each 10° rise in temperature. [(2)] According to this protocol, the reaction ratio doubles per each 10° increase in temperature compared with room temperature. [(3)] Accordingly, 3 months of incubation of composite tubes would correspond to 9 months of storage in a warehouse in the clinical setting.

Similar discs with the same dimensions were fabricated again of the aged composites as described earlier. The color parameters of each specimen were measured in triplicate by the same examiner under similar lighting and environmental conditions using Easy Shade spectrophotometer (as explained earlier). The data were recorded and tabulated in Excel software.

One-way ANOVA was applied to compare the a*, b* and L* parameters of the study groups.

3. RESULTS

Six discs were fabricated of each of the Enamel and Dentin types of each brand of composite resin before and after aging and the a*, b* and L* parameters of the specimens were measured.

The color change in green-red axis (a*) and blue-yellow axis (b*) and the change in lightness (L*) after aging compared with time zero are presented in Tables 2 to 4, respectively.

According to Table 2, the change in a* parameter was significant in Bisco Aelite Dentin, Bisco Aelite Enamel, GC Essentia Dentin, GC Essentia Enamel and 3M Z350 Dentin (P=0.00). This change in 3M Z350 Enamel was not significant (P=0.15). The color of Bisco Aelite Enamel shifted to greenness while the color of Bisco Aelite Dentin, GC Essentia Enamel, GC Essentia Dentin and 3M Z350 Dentin shifted to redness.

Table 2: Mean and standard deviation of color change in green-red (a*) axis after aging compared with time zero (n=6)

Composite	Mean	Std. Deviation	Mean a* before aging	Mean a* after aging	P value
Bisco-Aelite - Dentin	4.25	0.27	1.19	5.45	0.00
Bisco-Aelite -Enamel	-3.07	0.26	4.88	1.80	0.00
GC Essentia - Dentin	0.72	0.14	-0.23	0.48	0.00
GC Essentia -Enamel	1.45	0.15	-3.99	-2.54	0.00
3M Z350 -Dentin	1.17	0.23	0.76	1.94	0.00
3M Z350 -Enamel	0.76	0.49	-0.65	-0.16	0.15

As shown in Table 3, similar to a* axis, the change in b* parameter was significant in Bisco Aelite Dentin, Bisco Aelite Enamel, GC Essentia Dentin and GC Essentia Enamel (P=0.00). This change was also significant in 3M Z350 Dentin (P=0.01) but not significant in 3M Z350 Enamel (P=0.76).

Table 3: Mean and standard deviation of color change in blue-yellow (b*) axis after aging compared with time zero (n=6)

Composite	Mean	Std. Deviation	Mean b* before aging	Mean b* after aging	P value
Bisco-Aelite - Dentin	11.01	0.85	35.33	46.34	0.00
Bisco-Aelite -Enamel	-9.47	1.90	45.13	35.65	0.00
GC Essentia - Dentin	1.82	0.70	22.03	23.85	0.00
GC Essentia -Enamel	4.96	0.69	2.95	7.91	0.00
3M Z350 -Dentin	1.05	0.73	26.74	27.79	0.01
3M Z350 -Enamel	0.30	2.43	19.28	19.59	0.76

It should be noted that 3M Z350 Dentin experienced the least change (although significant) in this parameter after 3M Z350 Enamel (P=0.01). Nonetheless, in pairwise comparisons, these two groups had no significant difference with each other regarding changes in a* parameter (P=0.15).

Table 4: Mean and standard deviation of change in L* parameter after aging of composites compared with time zero (n=6)

Composite	Mean	Std. Deviation	Mean L* before aging	Mean L* after aging	P value
Bisco Aelite - Dentin	0.96	1.42	81.04	82.00	0.16
Bisco Aelite -Enamel	1.18	3.24	81.66	82.84	0.41
GC Essentia - Dentin	0.84	0.28	91.46	92.31	0.00
GC Essentia -Enamel	-0.01	0.56	86.77	86.75	0.95
3M Z350 -Dentin	2.29	0.99	88.81	91.11	0.00
3M Z350 -Enamel	4.71	1.86	85.30	90.02	0.00

The color of 3M Z350 Dentin, GC Essentia Enamel, GC Essentia Dentin and Bisco Aelite Dentin all shifted to blueness while the color of Bisco Aelite Enamel shifted to yellowness.

The results with regard to changes in L* parameter were different from the changes in a* and b* parameters. The change in L* parameter was significant in GC Essentia Dentin, 3M Z350 Dentin and 3M Z350 Enamel (P=0.00), and all these groups became lighter by an increase in L* parameter. The change in L* parameter was not significant in Bisco Aelite Dentin, Bisco Aelite Enamel and GC Essentia Enamel (P=0.16, P=0.41 and P=0.95, respectively).

Pairwise comparisons of composites regarding Δa*, Δb* and ΔL* are presented in table 5.

Table 5: Pairwise comparisons of composites regarding Δa*, Δb* and ΔL*

Composite resins		Δ a*		Δ b*		Δ L*	
		Mean difference	P-value	Mean difference	P-value	Mean difference	P-value
Bisco-dentin	Bisco-enamel	7.33000*	0.000	20.48333*	0.000	-0.22333	1.000
	GC-dentin	3.53833*	0.000	9.19000*	0.000	0.11167	1.000
	GC-enamel	2.80333*	0.000	6.04667*	0.000	0.97500	0.917
	3M-dentin	3.08000*	0.000	9.96000*	0.000	-1.33667	0.750
	3M-enamel	3.49500*	0.000	10.70333*	0.000	-3.75667*	0.008
Bisco-enamel	Bisco-dentin	-7.33000*	0.000	-20.48333*	0.000	0.22333	1.000
	GC-dentin	-3.79167*	0.000	-11.29333*	0.000	0.33500	0.999
	GC-enamel	-4.52667*	0.000	-14.43667*	0.000	1.19833	0.825
	3M-dentin	-4.25000*	0.000	-10.52333*	0.000	-1.11333	0.864
	3M-enamel	-3.83500*	0.000	-9.78000*	0.000	-3.53333*	0.013
GC-dentin	Bisco-dentin	-3.53833*	0.000	-9.19000*	0.000	-0.11167	1.000
	Bisco-enamel	3.79167*	0.000	11.29333*	0.000	-0.33500	0.999
	GC-enamel	-.73500*	0.001	-3.14333*	0.006	0.86333	0.949
	3M-dentin	-0.45833	0.089	0.77000	0.929	-1.44833	0.684
	3M-enamel	-0.04333	1.000	1.51333	0.439	-3.86833*	0.006
GC-enamel	Bisco-dentin	-2.80333*	0.000	-6.04667*	0.000	-0.97500	0.917
	Bisco-enamel	4.52667*	0.000	14.43667*	0.000	-1.19833	0.825
	GC-dentin	.73500*	0.001	3.14333*	0.006	-0.86333	0.949
	3M-dentin	0.27667	0.556	3.91333*	0.000	-2.31167	0.206
	3M-enamel	.69167*	0.003	4.65667*	0.000	-4.73167*	0.001
3M-dentin	Bisco-dentin	-3.08000*	0.000	-9.96000*	0.000	1.33667	0.750
	Bisco-enamel	4.25000*	0.000	10.52333*	0.000	1.11333	0.864
	GC-dentin	0.45833	0.089	-0.77000	0.929	1.44833	0.684
	GC-enamel	-0.27667	0.556	-3.91333*	0.000	2.31167	0.206
	3M-enamel	0.41500	0.151	0.74333	0.939	-2.42000	0.169
3M-enamel	Bisco-dentin	-3.49500*	0.000	-10.70333*	0.000	3.75667*	0.008
	Bisco-enamel	3.83500*	0.000	9.78000*	0.000	3.53333*	0.013
	GC-dentin	0.04333	1.000	-1.51333	0.439	3.86833*	0.006
	GC-enamel	-.69167*	0.003	-4.65667*	0.000	4.73167*	0.001
	3M-dentin	-0.41500	0.151	-0.74333	0.939	2.42000	0.169

Pairwise comparisons of composite resins regarding Δa*:

A significant difference was noted between Bisco Aelite Dentin and other groups (P=0.00).

A significant difference was noted between Bisco Aelite Enamel and other groups (P=0.00).

A significant difference was noted between GC Essentia Dentin with Bisco Aelite Dentin, Bisco Aelite Enamel and GC Essentia Enamel (P=0.00). The difference of GC Essentia Dentin with 3M Z350 Dentin and 3M Z350 Enamel was not significant (P>0.05). The difference of 3M Z350 Dentin with Bisco Aelite Dentin and Bisco Aelite Enamel was significant (P=0.00). Its difference with other groups was not significant.

The difference of 3M Z350 Enamel with Bisco Aelite Dentin, Bisco Aelite Enamel and GC Essentia Enamel was significant (P=0.000) but it had no significant difference with other groups.

Pairwise comparisons of composite resins regarding Δb*:

The difference between Bisco Aelite Dentin with other groups was significant (P=0.00).

The difference between Bisco Aelite Enamel with other groups was significant (P=0.00).

The difference between GC Essentia Enamel with other groups was significant (P=0.00).

The difference of GC Essentia Dentin with Bisco Aelite Dentin, Bisco Aelite Enamel and GC Essentia Enamel was significant (P=0.00). The difference of GC Essentia Dentin with 3M Z350 Dentin and 3M Z350 Enamel was not significant.

The difference of 3M Z350 Dentin with Bisco Aelite Dentin, Bisco Aelite Enamel and GC Essentia Enamel was also significant (P=0.00). The difference of 3M Z350 Dentin with GC Essentia Dentin and 3M Z350 Enamel was not significant.

Pairwise comparisons of composite resins regarding ΔL*:

The difference of 3M Z350 Enamel with Bisco Aelite Dentin, GC Essentia Dentin and GC Essentia Enamel was significant (P=0.00). The difference between 3M Z350 Enamel and Bisco Aelite Enamel was significant as well (P=0.01). Its difference with other groups was not significant.

The difference between other groups in ΔL* was not significant either.

4. DISCUSSION

Color stability of dental restorative materials is highly important from both the dentists' and patients' points of view. The quality of restorative treatments is evaluated based on their function and esthetics. Search for a restorative material with ideal function and esthetics led to improvements in the properties of composite resins over time. [6] According to Kolbeck et al, success of composite restorative materials depends on their color stability over time. Optimal color stability is an important criterion to consider when selecting the type of composite resin. [7] Thus, several studies have evaluated the effect of accelerated aging on color stability of dental materials. [8-11] However, aside from the different materials studied, the aforementioned studies did not use any standardized method for accelerated aging, which led to controversy in their findings. Therefore, no consensus has been reached regarding the appropriate time period for accelerated aging. [10, 12]

The current results revealed that aging of composite tubes affected the three color parameters of composite resins and our first null hypothesis was rejected. Hahnel et al, in their study in 2010 concluded that accelerated aging significantly affected the properties of composite, and the effect of duration of aging on composite degradation was greater than the effect of aging environment. [13] In 2012, Brahim Drubi-Filho et al. assessed the color stability of three types of composite resins following accelerated aging and reported that in each cycle of accelerated aging, lightness (L*) decreased to some extent. They concluded that a short period of accelerated aging would be sufficient to create an acceptable clinical color change in composites, and this change depended on the composite type. [14] Their results were in agreement with our findings.

According to Guler et al, color change of composite resins can be related to intrinsic or extrinsic factors. Intrinsic changes include color change of resin materials by themselves such as changes in resin matrix and matrix-filler interface while chemical discolorations are associated with change or oxidation of amine catalysts and the polymer matrix structure and unreacted methacrylate groups. (15)

Dietschi et al. assessed the color stability of 10 new generation (hybrid, microfilled and microfine hybrid) composite resins under different physical and chemical conditions and stated that the resistance of composites to color change is related to their low water sorption, high filler to resin ratio, small size of particles, decreased microhardness, and optimal filler-matrix coupling system. The resistance of new composites to discoloration depends on their internal structure and method of application. (16) Also, according to Ching et al, exposure to high temperature can cause short-term physical or long-term chemical changes in polymer materials. Exposure to ultraviolet light leads to discoloration of polymers and loss of their mechanical properties. Considering these limitations, composite polymer materials were developed.

Different nanoparticles, additives and fillers are incorporated in the composition of polymers using chemical and enzymatic methods to improve the thermal resistance of polymers. (17) In the present study, the composite tubes were incubated at 37°C under standard conditions to simulate their storage in a warehouse in the clinical setting.

In the present study, significant changes were noted in b* (green-yellow) axis in Bisco Aelite Dentin and Aelite Enamel, GC Essentia Dentin and Essential Enamel and 3M Z350 Dentin. In other words, 3M Z350 Dentin, GC Essentia Enamel and Essentia Dentin and Bisco Aelite Dentin all shifted to blue while Bisco Aelite Enamel shifted to yellow. Dlugokinski et al. proposed that a shift to yellowness may be due to the presence of residual camphorquinones in the composite resin. Despite the very low content of camphorquinones (around 0.03% to 0.1%) in composite resins, they can cause yellow discoloration over time. (18) Moreover, the byproducts of light curing of quaternary amines can cause yellowing of composite following exposure to light and heat, which are the two factors present in the accelerated aging protocol. (19) In our study, the majority of composite resins had a tendency to discoloration in blue axis, which may be due to improved properties of composite resins and reduction of camphorquinone in the composition of new products.

On the other hand, Filho et al. reported that Tetric Ceram composite experienced the greatest change in b* axis while Z250, which also contains camphorquinone (similar to other composite groups) experienced the least change in b* axis.

Furuse compared the color change of dimethacrylate and silorane composite resins following accelerated aging and reported that composites often experienced a reduction in L* and a* parameters and an increase in b* parameter. (12) In our study, composites that showed discoloration experienced an increase in all three color parameters such that they all became lighter and shifted to redness and blueness. However, in contrast to our findings in L* parameter, Brahim Drubi-Filho et al. reported that lightness (L*) decreased to some extent after each cycle of accelerated aging. (14) Pires-de-Souza et al. explained that one reason for lower color change of Z250 composite is the smaller size of fillers in its composition. Larger fillers have different degradation pattern compared with smaller fillers. Color perception directly correlates with light reflection from the composite surface, and higher variability in size of filler particles increases the light reflection from the composite surface and subsequently increases its color stability. (20) In our study, the behavior of composites in a* and b* axes was different from that in L* axis. Z350 Enamel did not show any change in a* and b* parameters in contrast to the remaining five composite resins. However, it experienced an increase in L* parameter and became lighter. This composite is a nanofilled composite with variable types and sizes of filler particles (silica fillers 20 nm in size, zirconia fillers 4-11 nm in size, and cluster fillers 0.6 to 10 μ in size).

According to Schulze, composites with lower concentration of fillers experience greater color change. (21) However, Drubi-Filho et al. did not confirm these findings. They showed that Tetric Ceram composite with maximum filler content experienced greater color change and P90 composite, despite having a lower filler content (55%), experienced moderate color change. In the present study, the changes in color parameters were minimal in Z350XT composite. It is a nanofilled composite with 78.5% filler volume; this finding can be attributed to high filler volume of this composite.

In 2003, Schulze et al. assessed the surface hardness and color stability of dental composites after accelerated aging. They reported that higher surface roughness results in higher light diffraction from the composite surface and reduction of its brightness. (21) Also, Campelle et al. showed a linear association between optical light diffraction and filler concentration.(22)

Chemical differences between composite resins such as the purity of oligomers and monomers and concentration/type of activators, initiators, inhibitors, oxidation of unreacted carbon-carbon double bonds and fillers may affect the color stability. In the study by Schulze, composite resins with lower filler contents had lower color stability, which was in line with older studies such as that of Eldiwany et al, in 1995.(23)

In the present study, the effect of aging of composite tube based on the type of composite (Enamel or Dentin) and its brand, on color change was not significant. Search of the literature by the authors yielded no study on the effect of aging of composite tube on color stability of Enamel and Dentin composite resins of different brands to compare our results with. Within the limitations of the current study, the results indicated that Enamel or Dentin type of aged composite tubes had no significant effect on their color stability.

5. CONCLUSION

According to the current results, accelerated aging of composite tubes according to the Arrhenius model (12 weeks of incubation at 37°C in dry environment, which corresponds to 9 months of storage in a warehouse in the clinical setting) affects the color change of composite resins. The magnitude of color change in 3M Z350 Enamel was lower than other composite resins (no color change was noted in a* and b* parameters).

6. ACKNOWLEDGMENT

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There is on conflict of interest.

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