

Effect of Brushing Time and Dentifrice Abrasiveness on Color Change and Surface Roughness of Resin Composites

Lourenço de Moraes Rego Roselino, Michelle Alexandra Chinelatti, Carla Cecília Alandia-Román, Fernanda de Carvalho Panzeri Pires-de-Souza

Department of Dental Materials and Prosthodontics, Dental School of Ribeirão Preto, USP – Universidade de São Paulo, Ribeirão Preto, SP, Brazil

Correspondence: Profa. Dra. Fernanda de Carvalho Panzeri Pires-de-Souza, Avenida do Café, s/n, Bairro Monte Alegre, 14040-904 Ribeirão Preto, SP, Brasil. Tel: +55-16-3315-3973. e-mail: ferpanzeri@usp.br

Dentifrice abrasiveness and brushing time may increase color change (ΔE) and surface roughness (ΔRa) of resin composites. This study aimed to evaluate the effect of mechanical brushing time of dentifrices with different abrasiveness on ΔE and ΔRa of nanofilled (Z350, 3M ESPE) and nanohybrid (Tetric N-Ceram, Ivoclar Vivadent) resin composites. Sixteen specimens (12 mm diameter x 2 mm thick) were fabricated using a white Teflon matrix of each resin composite and a ceramic (IPS e.max Ceram, Ivoclar Vivadent), used as control. After initial color readouts on white backgrounds (Spectrophotometer PCB 6807, Byk Gardner), with D65 standard illuminant, and surface roughness (Rugosimeter Surfcorde SE 1700, Kosalab) with cut-off=0.8 mm and speed=0.25 mm/s, specimens were assigned ($n=8$) according to the abrasiveness of the dentifrices: RDA* 68 (Colgate) and RDA* 180 (Colgate Total Plus Whitening). Specimens were submitted to mechanical brushing (58,400 cycles) and after every 14,600 cycles (1 year of brushing by a healthy individual), new color and surface roughness readouts were taken. Color stability was calculated by CIEDE2000. Data were analyzed by 3-way repeated measures ANOVA and Bonferroni test ($p<0.05$), and demonstrated that the dentifrice abrasiveness ($p=0.02$) and brushing time ($p<0.0001$) affected the ΔE of nanofilled resin composite. There was no difference on surface roughness of materials ($p=0.6752$) or brushing time ($p=0.7997$). In conclusion, the longer the brushing time and dentifrice abrasiveness, the greater the color change of the nanofilled resin composite. The surface roughness was not influenced by dentifrice abrasiveness.

Key Words: resin composites, dentifrice, abrasiveness, color, surface roughness.

Introduction

The quest for esthetics by both patients and dentists has led to the continuous improvement of Dentistry as regards innovations in restorative and rehabilitating materials and/or techniques, leading to restorations with an appearance closer to natural teeth. The characteristics of simulating dental structure color, translucence and surface smoothness has made resin composite the first choice among the restorative materials used in Dentistry.

In the chronology of resin composite development, a constant search for improvements in the physical-mechanical and chemical properties as well as esthetics has been observed. Among the improvements attained in contemporary resin composites are properties such as lower polymerization shrinkage and greater compressive strength, they are easier to manipulate and make it possible to obtain anatomically correct restorations (1). Nevertheless, color stability and surface roughness were still a problem inherent to the material and researchers are unanimous to recognize that direct restorations performed with conventional composites undergo changes in color (1-3) and surface roughness (4-7) with time.

The roughness of a restoration concerns the finest surface irregularities that occur due to the characteristics of

material (1), and the restorative (6) and polishing procedures (5,6). The chemical structure of resin composite - type of used oligomers or monomers, concentration/types of activators, initiators, inhibitors, oxidation of double carbon links and the particle/resin matrix bonding system (2,3), and filler particle characteristics have a direct impact on the surface roughness and staining of the resin composite (2).

Color change of resin composites also occurs due to the type of light used in light activation, time of exposure and resin matrix (1,2,8) It may also be influenced by incomplete polymerization of the material (1), lower degree of conversion (3), water sorption (8), diet and oral hygiene (9).

The effect of brushing on the surface roughness of resin composites is a significant factor in determining the performance of materials. As a result of this abrasive treatment, the greater the relative abrasiveness of the dentifrice, the greater will be the surface roughness of resin materials (4-6), consequently affecting the esthetics of the restoration (7-9). Different from resin composites, ceramic materials - considered inert - do not undergo great alterations during their useful life in the oral cavity (7).

Considering the foregoing and the hypothesis that the greater the dentifrice abrasiveness and brushing time, the greater the color change and surface roughness of resin

composites, the aim of this *in vitro* study was to evaluate the effect of brushing time and dentifrice abrasiveness on the color stability and surface roughness of esthetic restorative materials.

Material and Methods

The materials used in this study are described in Table 1.

Sixteen specimens of each material were obtained using a white Teflon matrix (12 mm diameter x 2 mm thick). The ceramic specimens were considered as a control group.

Resin composite specimens (shade A3) were obtained according to the incremental technique, the last increment covered with a glass slide to allow excess resin runoff and protect against formation of an oxygen inhibition layer. The specimens were photoactivated for 20 s using a LED light-emitting unit (FlashLite 1401; Discus Dental, Culver City, CA, USA), radiant emittance ≥ 1100 mW/cm², wavelength range between 460 and 480 nm). Next, they were polished with silicon carbide (SiC) papers (Norton Abrasives, Guarulhos, SP, Brazil) of decreasing abrasiveness (#600, #1200 and #2000 grit). The thickness of specimens was measured with a digital caliper (Digimes Precision Measuring Instruments, São Paulo, SP, Brazil).

Ceramic specimens (A3) were fabricated according to the two-firing condensation technique (Phoenix; Ceramco, Burlington, VT, USA) at an initial temperature of 450 °C and final temperature of 755 °C in vacuum, in accordance with the manufacturer's guidelines. After the last firing, specimens were polished with SiC papers (Norton) of decreasing abrasiveness (#100, #320, #1200 and #2000 grit), 30 s for each grit, and their dimensions were measured with a digital caliper. After this, the specimens of all

materials were stored in distilled water at 37 °C for 24 h.

Next, initial color readouts were taken (Spectrophotometer PCB 6807, Byk Gardner, Geretsried, Germany) on white background (L=94.86; a=0.84; b=0.11; Y=87.29) and measured at 45°, with D65 standard illuminant, according to CIE L* a* b* coordinates. This equipment has 30 LED lamps with 10 different colors arranged in a circle. The axes a* and b* are chromaticity coordinates, a* axis representing the color redness or greenness and the b* axis representing the color yellowness or blueness. The L* axis, perpendicular to a* and b*, represents the perceived color lightness.

Surface roughness (Rugosimeter Surfcoorder SE 1700; Kosakalab, Tokyo, Japan) was obtained in three measurements (cut-off=0.8 mm; speed=0.25 mm/s) on different surfaces of each specimen and the mean value was considered the initial surface roughness readout.

Specimens were randomly allocated into 2 groups (n=8), according to the abrasiveness of the dentifrices (Table 2). Mechanical brushing (Pepsodent; MAVTEC - Com. Peças, Acess. e Serv. Ltda. ME, Ribeirão Preto, SP, Brazil) was performed with soft toothbrushes (Tek; Johnson & Johnson Ind. Com Ltda., São José dos Campos, SP, Brazil) - one per specimen. The toothbrush heads were cut off and fitted into the clamp of the apparatus. Each brush/clamp set resulted in a final weight of 200 g.

Each specimen was fitted into a central circular hole of a plexiglass slide (Acrilpress Artifacts Ltda, Ribeirão Preto, SP, Brazil) to allow adaptation and fixation during mechanical brushing (course=3.8 cm; speed=356 rpm). The dentifrices were diluted in distilled water (ratio 1:1).

Specimens were individually submitted to a total of 58,400 cycles of mechanical brushing, corresponding to a

Table 1. Materials used in the study

Material	Manufacturer	Composition	Mean particle size	% Filler (by vol)	Mean color readouts (baseline)	Mean SR readouts (baseline)
Z350 (nanofilled)	3M ESPE, St Paul, MN, USA	Bis-GMA, Bis-EMA, UDMA, TEGDMA, zirconia and silica	5-20 nm n. ag. 0.6-4 µm ag.	59.5%	L* = 69.00 a* = 7.48 b* = 23.53	Ra = 0.177
Tetric N-Ceram (nanohybrid)	Ivoclar Vivadent AG, Schaan, Liechtenstein	19-20% Bis-GMA, Bis-EMA, UDMA 80-81% barium glass, ytterbium trifluoride, mixed oxides, and copolymer	40 nm 3000 nm	55-57%	L* = 68.42 a* = 8.41 b* = 23.23	Ra = 0.234
IPS e.max Ceram (ceramic)	Ivoclar Vivadent AG, Schaan, Liechtenstein	60% silicon dioxide, 40% aluminum trioxide, zinc peroxide, sodium oxide, potassium oxide, zirconium oxide, calcium oxide, phosphorus pentoxide, fluorides and pigments.	-	-	L* = 68.82 a* = 4.67 b* = 20.64	Ra = 0.366

n.a. = non-agglomerated; a. = agglomerated; SR = surface roughness; Bis-GMA: Bisphenol A glycol dimethacrylate; Bis-EMA = Ethoxylated bisphenol A glycol dimethacrylate; UDMA = Urethane dimethacrylate; TEGDMA = Triethylene glycol dimethacrylate.

4-year exposure to brushing by a healthy individual (10). After every 14,600 cycles, which corresponded to 1 year of brushing, the machine was switched off, the specimens were dried with absorbent papers to remove surface debris and submitted to new color and surface roughness readouts. The roughness readouts were performed perpendicular to the movement of brushing to record the wear resulting from this abrasive treatment. Both toothbrush head and the dentifrice solution were replaced after every cycle of brushing.

After this, new color readings were taken and the color change for each group was calculated by CIEDE2000 color change (ΔE_{00}) using the equation:

$$\Delta E_{00} = [(\Delta L' / K_L S_L)^2 + (\Delta C' / K_C S_C)^2 + (\Delta H' / K_H S_H)^2 + R_T (\Delta C' / K_C S_C)^2 (\Delta H' / K_H S_H)^2]^{1/2}$$

where $\Delta L'$, $\Delta C'$, and $\Delta H'$ are the differences in lightness, chroma and hue for a pair of samples in CIEDE2000 and R_T is a function (the so-called rotation function) that accounts for the interaction between chroma and hue differences in the blue region. Weighting functions, S_L , S_C , and S_H adjust the total color difference for variation in the location of the color difference pair in L^* , a^* and b^* coordinates and the parametric factors, K_L , K_C and K_H , are correction terms for experimental conditions as described by Sharma et al. (11).

Surface roughness alteration (ΔRa) was calculated using the equation:

$$\Delta Ra = Ra_f - Ra_i$$

where Ra_i is the initial and Ra_f the final roughness measurement.

After checking normality of the results, the values were submitted to statistical analysis by 3-way ANOVA for repeated measures and the Bonferroni test at a significance level of 5%.

Results

The studied resin composites presented similar baseline color readouts, as may be seen in Table 1.

Comparisons of the mean color change (ΔE) values are shown in Table 3. There was no significant color change

($p=0.9331$) for ceramic and nanohybrid resin composites regardless of dentifrice abrasiveness, except for the nanohybrid resin composite, which showed higher ΔE ($p=0.0332$) after brushing with RDA* 180, compared with RDA* 68, after 4 cycles of brushing.

The greater dentifrice abrasiveness, the greater the color change ($p<0.0001$) of the nanofilled resin composite, except after the first brushing cycle; at this time, no difference was observed in ΔE between both dentifrices ($p=0.4253$).

Regarding the nanofilled resin composite, mean ΔE values increased from the first to third cycles for both dentifrices; but when dentifrice RDA* 68 was used, ΔE decreased significantly ($p=0.0006$) after the fourth cycle compared to first and third cycles. For the RDA* 180 dentifrice, there was a significant color change ($p=0.0140$) between the first and third cycles, and no difference ($p=0.9581$) in ΔE after all other cycles.

The nanohybrid resin composite after brushing with dentifrice RDA* 68 resulted in greater and significant ($p=0.0450$) ΔE only after the third cycle, compared to second cycle. There was no difference among other comparisons ($p=0.9910$). After brushing with RDA* 180 dentifrice, ΔE was higher after the last cycle, compared to second and third cycles, ($p=0.0013$ and $p=0.0073$, respectively), which did not show difference ($p=0.9425$) between them and the first cycle ($p=0.0584/p=0.1950$), which did not present difference ($p=0.5410$) in comparison with last cycle.

Color data of the ceramic showed no significant difference ($p>0.05$) in ΔE values between all brushing cycles when the tested dentifrices were used.

Comparing the materials (Fig. 1), after all cycles of brushing with dentifrice RDA* 68, the nanofilled resin composite demonstrated higher values for ΔE ($p<0.0001$) than other materials, which did not present difference among them ($p=0.9331$). There was no difference ($p>0.05$) between materials after brushing with dentifrice RDA* 180.

Table 4 shows the mean surface roughness values (ΔRa) of the different materials considering the brushing cycles and dentifrices. The ΔRa values of ceramic and nanofilled resin composite did not differ significantly ($p>0.9999$) for every brushing cycle when the dentifrices were evaluated.

Table 2. Groups formed according to the treatments according to the abrasiveness of the dentifrices

Group	Treatment	Dentifrice	Composition	Manufacturer
1	Brushing Dentifrice RDA* 68	Colgate	Water, calcium carbonate, sorbitol, sodium lauryl sulphate, sodium monofluorophosphate, aroma, cellulose gum, sodium silicate, sodium bicarbonate, sodium saccharin, xanthan gum, methylparaben and propylparaben	Colgate - Palmolive Company, São Bernardo do Campo, SP, Brazil
2	Brushing Dentifrice RDA* 180	Colgate Total Plus Whitening	Water, sorbitol, hydrated silica, sodium lauryl sulphate, copolymer, aroma, carrageenan, sodium hydroxide, sodium fluoride, sodium saccharin and Triclosan	Colgate - Palmolive Company, São Bernardo do Campo, SP, Brazil

Only the nanohybrid resin composite showed higher ΔRa values after the third brushing cycle when dentifrice RDA* 180 was used, different results ($p=0.0002$) after the first cycle.

Comparing the dentifrices for each material, there was no difference in ΔRa values, except for the nanohybrid resin composite brushed with RDA* 180, which presented higher ΔRa than RDA* 68 after the third ($p<0.0001$) and fourth ($p=0.0078$) cycles.

When the materials were analyzed, dentifrice RDA* 68 was not able to significantly change ($p>0.05$) the surface roughness of the materials (Fig. 2). After brushing with RDA* 180, the nanohybrid resin composite presented higher values of ΔRa , different ($p<0.05$) from ceramic from the second to fourth cycles ($p=0.0191$, $p<0.0001$ and $p=0.0078$, respectively). There was no difference ($p>0.05$) concerning the nanofilled resin composite for all cycles (Fig. 2).

Discussion

This study evaluated the color stability and surface roughness of two types of resin composites and a ceramic (control) submitted to mechanical brushing with dentifrices of RDA* abrasiveness 68 and 180 for up to 58,400 cycles, simulating 4 years of clinical brushing. Based on the results obtained in the present study, the hypothesis may be partially accepted, since the greater dentifrice abrasiveness

and brushing time, the greater the color change found for the nanofilled resin composite; there was no difference in color stability for the other materials. Regarding the surface roughness, the materials were not affected by dentifrice abrasiveness and brushing time.

Clinically, the aim of brushing with dentifrices is to polish tooth and restorations surfaces (4), in order to obtain smooth surfaces and leaving them less subject to staining (8). Obviously, these procedures have a direct influence on the esthetics and longevity of the material, because it is almost impossible to achieve restorations with perfectly smooth surfaces after they are performed (12).

The mechanical brushing method is suitable for simulating normal oral hygiene procedures, because it standardizes the applied force, distance and frequency of brushing on the samples (6,8), imposing a process of wear on the material (13). However, this abrasion is not the only factor to which restorative materials are subjected in the oral cavity. Brushing may cause a polishing action, depending on the interaction between the sample surfaces and the abrasive particles in the dentifrice (4).

In the present study, brushing was simulated for up to 4 years, with color and roughness evaluations performed after every 1 year simulated period. Considering that in normal clinical conditions, 40 brushing cycles per day are applied (10), in one year the number of cycles corresponds

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Table 3. Comparison (3-way ANOVA, repeated measures, Bonferroni, $p<0.05$) of ΔE means (S.D.) of materials according to the brushing time and the type of dentifrice.

Material	Cycle	RDA* 68	RDA* 180
Z350 (nanofilled)	1	0.85(0.16) ^{Ca}	0.61(0.34) ^{Ba}
	2	1.15(0.20) ^{Ba}	0.78(0.29) ^{ABb}
	3	1.49(0.14) ^{Aa}	0.87(0.21) ^{Ab}
	4	1.17(0.20) ^{Ba}	0.82(0.31) ^{ABb}
Tetric N-Ceram (nanohybrid)	1	0.51(0.23) ^{ABa}	0.77(0.34) ^{ABa}
	2	0.40(0.19) ^{Ba}	0.56(0.25) ^{Ba}
	3	0.61(0.23) ^{Aa}	0.60(0.17) ^{Ba}
	4	0.49(0.16) ^{ABb}	0.88(0.32) ^{Aa}
IPS e.max Ceram (ceramic)	1	0.39(0.25) ^{Aa}	0.52(0.44) ^{Aa}
	2	0.39(0.24) ^{Aa}	0.48(0.27) ^{Aa}
	3	0.43(0.23) ^{Aa}	0.54(0.29) ^{Aa}
	4	0.54(0.21) ^{Aa}	0.62(0.31) ^{Aa}

Different letters, lowercase in rows and uppercase in columns, indicate statistically significant difference ($p<0.05$).

Table 4. Comparison (3-way ANOVA, repeated measures, Bonferroni, $p<0.05$) of mean values (S.D.) of surface roughness (ΔRa) of materials according to the brushing time and the type of dentifrice

Material	Cycle	RDA* 68	RDA* 180
Z350 (nanofilled)	1	0.017(0.04) ^{aA}	0.080(0.07) ^{aA}
	2	0.026(0.02) ^{aA}	0.112(0.10) ^{aA}
	3	0.059(0.03) ^{aA}	0.170(0.13) ^{aA}
	4	0.059(0.06) ^{aA}	0.170(0.13) ^{aA}
Tetric N-Ceram (nanohybrid)	1	0.017(0.12) ^{aA}	0.139(0.11) ^{aB}
	2	0.048(0.13) ^{aA}	0.201(0.09) ^{aAB}
	3	0.042(0.10) ^{bA}	0.333(0.07) ^{aA}
	4	0.055(0.13) ^{bA}	0.248(0.14) ^{aAB}
IPS e.max Ceram (ceramic)	1	0.064(0.27) ^{aA}	0.036(0.10) ^{aA}
	2	0.087(0.28) ^{aA}	0.003(0.14) ^{aA}
	3	0.090(0.29) ^{aA}	0.003(0.15) ^{aA}
	4	0.091(0.25) ^{aA}	0.027(0.18) ^{aA}

Different letters, lowercase in rows and uppercase in columns, indicate statistically significant difference ($p<0.05$).

to 14,600. According to some authors (4,14), 10,000 cycles would be sufficient to simulate one year of brushing. Other studies (4-7) have proved that this is an adequate method that allows evaluating the efficiency of different dentifrices and mean roughness of restorative materials.

The larger the abrasive particle size, the greater the abrasiveness of the dentifrice (15) and the more effective the removal of staining from pigmented structures (16). The whitening dentifrices (RDA* 180) contain specific chemical components in their formulation, which reduce staining (5) and were designed to maximize cleaning and

minimizing wear (17), irrespective of having any physical effect on the material.

The type of abrasive agent can influence the abrasiveness of materials. In the present study, the RDA* 180 dentifrice has silica in its composition (Table 2), which is less abrasive than calcium carbonate (15), component of dentifrice RDA* 68. This may justify the results found in this study, that demonstrated higher ΔE values after brushing with dentifrices RDA* 68 than with RDA* 180 for the nanofilled resin composite.

As regards the influence of brushing time on color stability, ΔE value did not change, except for the nanofilled resin composite, which exhibited higher ΔE values up to the third cycle of brushing for both dentifrices.

It is known that the surface of a resin composite presents a higher resin content when photopolymerized under a certain pressure against a smooth surface (18), such as the placement of a glass slide. With the increase in the number of brushing cycles, it is reasonable to believe that there was a gradual removal of this matrix-rich layer (5). This may have contributed to the color change of the nanofilled resin composite after the third cycle, in which the superficial staining may have been removed by wear (19).

Some studies have shown that the type of monomer interferes in the level of water sorption of the resin composite (1,19) and this may lead to color change (12). Due to the low conversion levels of the TEGDMA monomer, it is predisposed to water sorption, increasing the solubility of the polymer formed between the polymer matrix bonds (20), causing deterioration of this structure and of the matrix/filler particle interface, resulting in greater color change (9). The higher

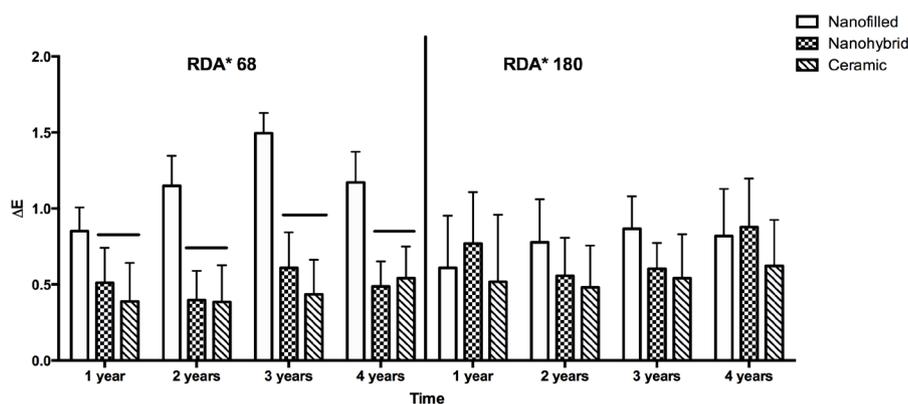


Figure 1. Comparison (3-way ANOVA, repeated measures, Bonferroni, $p < 0.05$) of ΔE mean values of materials according to the brushing time and the type of dentifrice. Horizontal line over the columns indicates no significant difference ($p < 0.05$). For all comparisons of RDA* 180, $p > 0.05$.

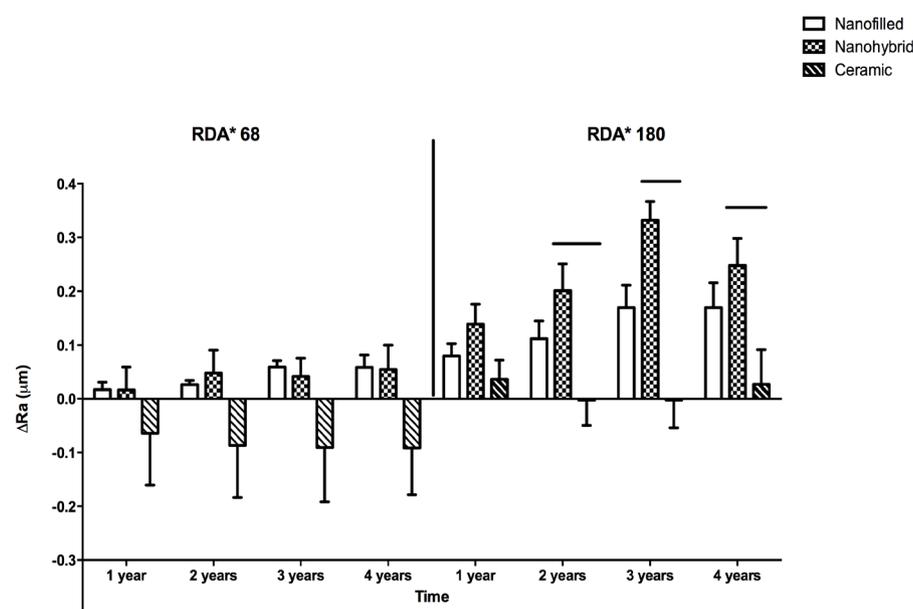


Figure 2. Comparison (3-way ANOVA repeated measures, Bonferroni, $p < 0.05$) of ΔRa mean values of materials according to the brushing time and type of dentifrice. Horizontal line over the columns indicates significant difference ($p < 0.05$). For all comparisons of RDA* 68, $p > 0.05$.

the degree of water sorption of a resin composite, the lower the color stability, due to the increase in the free volume of formed polymer. Consequently, more space is available for diffusion of water molecules into the polymeric structure (3). This phenomenon is called composite plasticization (21) and it causes softening of the polymer matrix, promoting a greater color change of the resin composite (9).

As regards the filler particles, resin composites with larger particles are more susceptible to water sorption and color change (22), a phenomenon explained by the weak bond at the matrix/filler interface, which is broken by water sorption, changing the manner in which light is dispersed by the particles (20). In addition, composites with low concentration of filler particles present higher ΔE values (22).

In the present study, the nanofilled resin composite, which has agglomerated particle sizes from 0.6 to 1.4 μm (59.5% by volume), presented the highest levels of ΔE when submitted to brushing with dentifrice RDA* 68 in comparison with the nanohybrid resin composite, which has particle sizes ranging from 0.04 to 3.0 μm (55 to 57% by volume). Therefore, the results found in the present study are not in agreement with those of the previously cited authors. Some authors have shown that the percentage of filler particles by volume per se may not explain the variations in water sorption and discoloration of a resin composite (2,3,20).

The nanofilled resin composite has aggregated filler particles and glass particles that are susceptible to porosities with the absorption of water, resulting in staining and color change (9,12). Therefore, considering that the nanofilled resin composite contains TEGDMA and this leads to greater degradation of the matrix/filler particle bond, the action of brushing on this resin composite may have caused greater removal of these particles from the surface (23), diminishing its color stability.

Abrasion gradually removes the resin matrix among the filler particles of composites; the unsupported filler particles are easily eliminated, leaving a particle-free resin layer which is rapidly abraded and the process becomes continuous (24). However, the influence of the polymer degree of conversion and the volume ratio of filler in the matrix on the resistance to abrasion of resin composites (24). Since the agglomerated particle sizes of nanoparticle resin composites are smaller than 2 μm , the abrasion process is comparatively slower than for hybrid resin composites (14).

Although studies have found no correlation between resin composite particle size and surface roughness after brushing (14,25), as related in the present study, it was expected that the nanohybrid resin composite, being a composite with larger particles, would present a higher surface roughness after mechanical brushing (6) due to

the removal of superficial particles of composite.

When the resin composite is a hybrid type, this removal of particles would leave pores as large as the size of its particles in the material surface. As the nanosized resin composite has smaller particles, the removal of particles would leave smaller pores. However, one has to consider that the nanohybrid resin composite has particles sizes ranging from 40 to 3000 nm, whereas the nanofilled resin composite has particles of 5 to 20 nm in size, but they are agglomerated into particle sizes that reach 600 to 1400 nm, which exceeds the sizes of the smaller particles in the nanohybrid resin composite.

The resin composites did not present differences in surface roughness after brushing with different type of dentifrice. This may be justified by the fact that the abrasion is not directly related to the whitening agent and depends on the set of components in the dentifrice formulation (5).

Other results may be explained by the size and distribution of the nanohybrid resin composite filler particles that allow for a more consistent polishing of the resin composite (6). This is because smaller and more homogeneous filler particles would be closer to one another, thus reducing the amount of organic matrix that may be exposed and diminishing the wear after brushing (25). Furthermore, although the exposure of filler particles occurs during the procedure of polishing by brushing, the particles of the nanohybrid resin composite, even the larger ones, may have been worn along with the polymer matrix during the brushing cycles, instead of being removed (9).

A limitation of the study was that brushing was performed with dentifrice diluted in distilled water. One understands that clinically, this dilution occurs in saliva, and its special properties such as the presence of enzymes, specific proteins and ions, may diminish the effect of toothbrush roughness on the samples.

It was concluded that the longer the mechanical brushing time and the dentifrice abrasiveness, the greater the color change of nanofilled resin composites. The length of brushing time and dentifrice abrasiveness did not alter the surface roughness of resin composites.

Resumo

A abrasividade do dentífrico e o tempo de escovação podem aumentar a alteração de cor (ΔE) e rugosidade de superfície (ΔRa) das resinas compostas. Este estudo teve como objetivo avaliar o efeito do tempo de escovação mecânica com dentífricos de diferentes abrasividades, sobre o ΔE e a ΔRa das resinas compostas (nanoparticulada, Z350, 3M ESPE e nanohíbrida, Tetric N-Ceram, Ivoclar Vivadent). Dezesesseis amostras (12 mm de diâmetro x 2 mm de espessura) foram obtidas utilizando uma matriz de teflon branca, de cada resina composta e uma cerâmica (IPS e.max Ceram, Ivoclar Vivadent), considerada como controle. Após as leituras iniciais de cor sobre fundo branco (Espectrofotômetro PCB 6807, Byk Gardner), com iluminante padrão D65, e de rugosidade de superfície (Rugosímetro Surfcoorder SE 1700, Kosalab), com cut-off=0,8 mm e velocidade=0,25 mm/s, as amostras foram separadas (n=8) de

acordo com a abrasividade dos dentífricos: RDA* 68 (Colgate) e RDA* 180 (Colgate Total Plus Whitening). Amostras foram submetidas a escovação mecânica (58.400 ciclos), sendo que a cada 14.600 ciclos (1 ano de escovação por um indivíduo saudável), novas leituras de cor e rugosidade de superfície foram realizadas. A estabilidade de cor foi calculada segundo CIEDE2000. Os dados foram analisados (3-way ANOVA medidas repetidas, teste de Bonferroni, $p < 0,05$), e demonstrou-se que a abrasividade dos dentífricos ($p = 0,02$) e o tempo de escovação ($p < 0,0001$) afetaram o ΔE da resina composta nanoparticulada. A rugosidade de superfície não foi influenciada pela abrasividade dos dentífricos ($p = 0,6752$) ou tempo de escovação ($p = 0,7997$). Concluiu-se que quanto maior o tempo de escovação mecânica e a abrasividade do dentífrico, maior a alteração de cor da resina composta nanoparticulada. A rugosidade de superfície não foi influenciada pela abrasividade do dentífrico.

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