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Effects of bleaching agents on three different bonding agents in Cl.V composite resin restoration (in vitro comparative study)

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Abstract

Bleaching the discolored teeth may affect the tooth/composite interface. This action found to be differing when different bonding agents were used.

Aim of the study was to evaluate the effect of vital tooth bleaching on microleakage of existent class V composite resin restorations bonded with three dental bonding agents.

Class V cavities were prepared on buccal surfaces of 60 intact, extracted human mandibular premolar teeth with gingival margins in cementum and occlusal margins in enamel, then these 60 teeth were randomly divided into 3 groups. Cavities in each group were treated with one of the following bonding agents: Adper™ Single Bond Pluse Adhesive (3M-ESPE) [group A], Tetric N-Bond (ivoclar, vivadent) [group T] and Stae (SDI) [group S]. All teeth were restored with Tetric N-Ceram light activated composite material. Each group was equally subdivided into control [AC, TC and SC] and bleached [AB, TB and SB] subgroups (n = 10). The bleached subgroups were bleached with 8% carbamide peroxide (Pola Paint, SDI, Australia) for 30 minutes twice a day for 14 days (according to the manufacturer's instruction). Microleakage scores were evaluated on the incisal and cervical walls. Data were analyzed using Paired –Samples t- test.

Bleaching with carbamide peroxide paint significantly increased the microleakage of composite restorations in Stae group at dentinal walls ($P \leq 0.05$). Bleaching had no effect on microleakage of restorations in the Adper™ Single Bond Plus Adhesive and Tetric N-Bond groups.

Vital tooth bleaching with carbamide peroxide paint has an adverse effect on marginal seal of dentinal walls of existent composite resin restorations bonded with Stae adhesive.

Introduction

The demand for having more esthetic teeth and restorations has led several studies to be done in the field of tooth bleaching and its effects on the properties of teeth and the quality of composite restorations[1]. While altered surface texture, hardness, fracture toughness[2] and increased surface roughness of enamel have been reported [3], some studies have shown little or no effect on the physical properties of enamel [4] . Hydrogen peroxide has been suspected to cause denaturation of proteins in the organic components of dentin and enamel, reduce microhardness values and result in changes in the mechanical properties of dentin, and could reduce the bond

between resin restorations and tooth [5]. It is suggested that dentin is more affected by hydroxide base materials due to its less mineral content and more organic matrix [6]. The success of composite restorations depends on bonding them to hard tooth tissue that will retain the restoration to the cavity preparation and prevent microleakage [3]. The dental adhesives used in dentistry have different tooth-composite interface morphologies [7], different bond strengths [8] and different abilities in microleakage prevention [9]. So, the bonded interfaces may be affected by the bleaching agents differently. Some researchers have investigated the effects of preoperative bleaching on microleakage and sealing ability of tooth colored restorative materials [10, 11].

Some researchers also have studied the effects of bleaching agents on microleakage of existence restorations. The researches done by Crim[12], Owens et al.[13], Ulukapi et al.[14] and Moosavi et al [15], have indicated that bleaching is an effective factor on the sealing ability of existent composite restorations whereas Klukowska et al.[16], Khoroushi et al.[17] and White et al.[18] showed that bleaching had no influence on microleakage of composite restorations. The purpose of this in vitro experimental study was to evaluate the effect of bleaching with carbamide peroxide (Pola Paint, SDI, Australia) on the microleakage of existent composite restorations using three types of adhesive systems.

Materials and Methods

Sixty, non-carious extracted human mandibular premolar teeth were selected, cleaned and stored in 0.9% Sodium Chloride (normal saline) until ready to use. Standardized class V cavity preparations (3 × 2 × 2 mm) were placed in the buccal surfaces at the cemento-enamel junction, with the occlusal margins in enamel and the gingival margins in cementum. The enamel margin of restoration was beveled with a carborundum point (Komet, Germany). Teeth were randomly divided into 3 groups (20 teeth each) according to the type of bonding agent being used. Each group then subdivided into control and bleached subgroups (10 teeth each). After completion of the preparations, the bonding agents, Adper™ Single Bond Plus Adhesive (3M-ESPE), Tetric N-Bond(ivoclar ,vivadent) and Stae (SDI) were applied according to the manufacturers' instructions (Table 1) on the control and bleached groups to form AC(control group with Adper™ Single Bond Plus Adhesive) and AB(bleached group with Adper™ Single Bond Plus Adhesive), TC (control group with Tetric N-Bond) and TB (bleached group with Tetric N-Bond), SC (control group with Stae adhesive) and SB (bleached group with Stae adhesive) groups, respectively. The cavities were incrementally restored with a light curing composite material, Tetric N-Ceram, in a total of three equal increments, each one photoactivated for 40 seconds (Radii-Cal, SDI, Australia). The restorations were finished and polished with polishing bur (Komet, Germany). The bleached group's teeth were bleached with vital bleaching method. The teeth were bleached with 8% carbamide peroxide (Pola Paint, SDI, Australia) twice a day for 14 days according to the manufacturers' instruction (apply a thin layer of Pola Paint gel to the clean and dry front surfaces of the teeth, and leave the gel on teeth for 30 minutes, then remove the Pola Paint gel by brushing with a tooth brush). Then the teeth were stored in artificial saliva at 37°C. During the dye penetration testing, apical opening of teeth were occluded with acrylic resin. The tooth

surfaces were covered with two coats of nail varnish except the area of restoration and 1 mm around its margins and then, immersed in 1% Methylene blue solution for 7 days at room temperature. The teeth were then removed from the dye and washed under running tap water. Then, the teeth were sectioned longitudinally in a buccolingual direction using a diamond disc on a slow speed handpiece. The degrees of dye penetration in the enamel and dentin cavity walls were assessed under a stereomicroscope at x10 magnification. The following microleakage scores were used to assess the extent of dye penetration at the dentin and enamel walls [19] : 0= no dye penetration, 1 = dye penetration less than halfway to the axial wall, 2= dye penetration greater than halfway to the axial wall but not involving it and 3= dye penetration along the axial wall. The data were analyzed using Paired – Samples T Test (Table 2 and 3).

Results

Regarding degrees of microleakage for enamel (Tab.2) and dentinal (Tab.3)walls, results of this study showed that score (0) microleakage was greater in all groups accept bleached group of Stae adhesive in enamel wall and bleached groups of Tetric N-Bond and Stae adhesive in dentinal wall .

Table 4 shows that there was no significant difference between the microleakage scores of the control and bleached groups of Adper™ Single Bond Pluse Adhesive and Tetric N-Bond at the enamel margins ($P \leq 0.05$). The microleakage scores of enamel walls for Stae bleached group were significantly greater than that for Adper™ Single Bond Pluse Adhesive and Tetric N-Bond ($P \leq 0.05$). There was no significant difference between the bleached groups of Adper™ Single Bond Pluse Adhesive and Tetric N-Bond ($P \leq 0.05$).

Table 5 shows that there was a significant difference between the control and bleached groups of Tetric N-Bond and Stae adhesive for gingival margins ($P \leq 0.05$) while for Adper™ Single Bond Pluse Adhesive there was no significant difference at the gingival margins. There was no significant difference among the bleached groups of three adhesives at gingival margins ($P \leq 0.05$).

There was no significant difference among the control groups of three dentin bonding agents at enamel and gingival margins ($P \leq 0.05$).

Discussion

The results of this study suggest that in the situation of using Adper™ Single Bond Pluse Adhesive as an adhesive system, bleaching has no significant effect on rising the enamel and gingival microleakage scores of existent restorations. It seems that the appropriate bonds in cavity margins [6] are likely to protect the restoration margins from the risk of peroxide penetration. This fact besides it's least microleakage scores in the control groups, could be the indicators of the effectiveness of this adhesive for clinical applications.

For Tetric N-Bond adhesive, bleaching caused a significant rising in microleakage scores in dentinal margin whereas in the enamel, no significant change in microleakage was seen. These findings indicate that dentinal margins may be more affected by bleaching agents when this adhesive system is used. These effects may be due to less mineral content and more organic matrix of dentin.[6] Either hydrogen peroxide or carbamide peroxide may denature dentin proteins, resulting in morphological changes

that could reduce the bond between resin restorations and dentin.[10] The exposure of dentin to bleaching agents reduces microhardness values[9], and the alterations in dentinal organic/inorganic composition may also result in changes in mechanical properties of dentin [4] that may make it more prone to be affected by bleaching agents. Ulukapi et al. suggested that both pre and post operative bleaching with 10% carbamide peroxide can increase microleakage scores of composite restorations margins [14]. These findings are not in agreement with the results of the present study regarding Adper™ Single Bond Pluse Adhesive and Tetric N-Bond adhesive groups, and may be due to differences between the kinds of adhesives and restorative materials, bleaching time and some other factors.

Khoroushi et al.[17] showed that light activated bleaching did not significantly affect the microleakage of existing tooth-colored restorations. The findings of her study were not similar to the findings of this study and this may be due to using of different restorative materials or bleaching agents.

Klukowska et al.[16] study the effects of different concentrations of hydrogen peroxide and carbamide peroxide agents on the enamel margin microleakage of composite restorations, In their study and also in White et al.[18] research, in agreement with findings of this study, bleaching agents may not increase the microleakage scores as Adper™ Single Bond Pluse Adhesive in this study.

Moosavi et al.[15] found that postoperative bleaching with carbamide peroxide may increase microleakage in the dentinal margins of composite restorations. Their results were in agreement with findings of this study.

Conclusion

Under the condition of this study:

1. Post operative bleaching could increase the microleakage scores of composite restorations dentinal margins, treated with Tetric N-Bond Adhesive. However, this procedure did not affect enamel margins.
2. Adper™ Single Bond Pluse Adhesive exhibited the best enamel and dentinal marginal sealing among bleached groups.
3. Stae Adhesive showed the most dentinal microleakage among unbleached groups of three adhesives.

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Table 1.Technique used for each adhesive

Adhesive	technique
Adper™ Single Bond Pluse Adhesive	Etch 15 seconds, 37%H3PO4,rinse,apply 2-3 coats of adhesive, air dry, light polymerize for 10 seconds
Tetric N-Bond	Etch 15 seconds, 37%H3PO4,rinse,apply adhesive, air dry, light polymerize for 10 seconds
Stae	Etch 20 seconds, 37% H3PO4 , rinse, apply adhesive , air dry , light polymerize for 10 seconds

Table 2: Microleakage degrees of the control and bleached groups of the three bonding agents at the enamel margins.

Groups	Score 0	Score 1	Score 2	Score 3
AC	١٠			
AB	٩	١		
TC	٩	١		
TB	٧	٢	١	
SC	٩	١		
SB	٥	٣	١	١

Table 3: Microleakage degrees of the control and bleached groups of the three bonding agents at the gingival margins.

Groups	Score 0	Score 1	Score 2	Score 3
AC	٩	١		
AB	٧		١	٢
TC	٩	١		
TB	٦		١	٣
SC	٧	٣		
SB	٥	١	١	٣

Table 4: Statistical analysis of microleakage degrees for the control and bleached groups of the three bonding agents at the enamel margins.

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 ac - tc	-.100	.316	.100	-.326	.126	-1.000	9	.343
Pair 2 ac - sc	-.100	.316	.100	-.326	.126	-1.000	9	.343
Pair 4 ab - tb	-.300	.483	.153	-.646	.046	-1.964	9	.081
Pair 5 ab - sb	-.700	.823	.260	-1.289	-.111	-2.689	9	.025
Pair 6 tb - sb	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 7 ac - ab	-.100	.316	.100	-.326	.126	-1.000	9	.343
Pair 8 tc - tb	-.300	.483	.153	-.646	.046	-1.964	9	.081
Pair 9 sc - sb	-.700	.823	.260	-1.289	-.111	-2.689	9	.025

Table 5: Statistical analysis of microleakage degrees for the control and bleached groups of the three bonding agents at the gingival margins.

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 2 ac - sc	-.200	.422	.133	-.502	.102	-1.500	9	.168
Pair 3 tc - sc	-.200	.422	.133	-.502	.102	-1.500	9	.168
Pair 4 ab - tb	-.300	.675	.213	-.783	.183	-1.406	9	.193
Pair 5 ab - sb	-.400	.699	.221	-.900	.100	-1.809	9	.104
Pair 6 tb - sb	-.100	.316	.100	-.326	.126	-1.000	9	.343
Pair 7 ac - ab	-.700	1.160	.367	-1.529	.129	-1.909	9	.089
Pair 8 tc - tb	-1.000	1.333	.422	-1.954	-.046	-2.372	9	.042
Pair 9 sc - sb	-.900	.994	.314	-1.611	-.189	-2.862	9	.019