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Original Article

The effect of different concentrations of carbamide peroxide on the marginal seal of composite restorations bonded with a self-etch adhesive

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Abstract

Introduction: Bleaching of discolored tooth may affect the tooth/composite interface. The aim of this study was to evaluate the effect of different concentrations of carbamide peroxide (CP) on the marginal seal of composite restorations bonded with a self-etch adhesive.

Materials &Methods: In this experimental study Class V cavities were prepared on the buccal and lingual surfaces of 24 intact extracted human molar teeth with gingival margins in dentin and occlusal margins in enamel. The cavities were restored using the adhesive system Clearfil SE Bond and the composite Filtek Z250. Finally, they were randomly divided into four groups (1 control and 3 bleached groups). The control group was kept for two weeks in distilled water at 37° C. The bleached groups were bleached with 10%, 22% and 35% CP gel for 8 hours a day for 14 days. After that, the samples were immersed in 0.5% fuchsin solution and sectioned. Then gingival microleakage was graded. Data was analyzed using Kruskal Wallis and Mann Whitney U test ($P \leq 0.05$).

Results: Microleakage was observed in the gingival wall of all groups. There was a significant difference between the control group and the bleached groups. Microleakage in the 22% bleached group was less than the other concentrations, but this difference was not significant.

Conclusion: Bleaching with different concentrations of CP can increase the microleakage of the gingival wall of Composite restorations bonded with clearfil SE Bond self-etch adhesive and does not recommend.

Keywords: Carbamide peroxide, Adhesives, Composite resins, Dentin, Dental enamel

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اثر غلظت های مختلف کاربامید پراکساید بر سیل لبه ای ترمیم های کامپوزیتی باند شده با ادهزیو سلف اچ

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چکیده

مقدمه: بلیچینگ دندان می تواند بر حد فاصل دندان و ترمیم کامپوزیت تاثیرگذار باشد. هدف از این مطالعه ارزیابی اثر سه غلظت کاربامید پراکساید بر ریزنشت لبه ای ترمیم های کامپوزیتی باند شده با ادهزیو سلف اچ می باشد.

مواد و روش ها: در این مطالعه ی تجربی آزمایشگاهی حفرات کلاس پنج در سطوح باکال و لینگوال ۲۴ عدد دندان مولر انسانی کشیده شده سالم تهیه شدند، به گونه ای که لبه ی ژنژیوالی در عاج و لبه ی اکلوزالی در مینا قرار گیرد. حفرات با استفاده از عامل باندینگ Clearfil SE Bond و رزین کامپوزیت Z250 Filtek ترمیم شده و بطور تصادفی به چهار گروه تقسیم شدند. گروه کنترل به مدت دوهفته در آب مقطر ۳۷ درجه سانتی گراد نگهداری شد. سه گروه بلیچ شده به وسیله ی ژل کاربامید پراکساید ۱۰٪، ۲۲٪ و ۳۵٪ روزی ۸ ساعت به مدت ۱۴ روز بلیچ شدند. پس از آن نمونه ها در محلول فوشین ۰/۵٪ غوطه ور شده و برش داده شدند. ریزنشت ژنژیوالی درجه بندی گردیده و یافته ها با آزمون هایKruskal Wallis و Mann Whitney U test آنالیز شدند ($p\leq 0.05$).

یافته ها: میکرولیکیج در لبه ژنزیوالی همه گروهها دیده شد. بین میزان ریزنشت گروه کنترل و گروه های بلیچینگ تفاوت معناداری وجود داشت. ریزنشت در گروه بلیچ شده با غلظت ۲۲٪ کمتر از دو غلظت دیگر بود اما تفاوت معناداری وجود نداشت.

نتیجه گیری: استفاده از ماده بلیچینگ کاربامید پراکساید با غلظت های مختلف به علت افزایش ریزنشت لبه ژنژیوال ترمیم های کامپوزیتی باند شده با ادهزیو سلف اچ Clearfil SE Bond توصیه نمی شود.

واژگان کلیدی: کاربامید پراکساید، ادهزیو،رزین کامپوزیت، عاج دندان، مینای دندان

Introduction

The growing demand for esthetic treatments and tooth-colored restorations had led to multiple studies in the field of tooth bleaching and its effects on the properties of teeth and the quality of composite restorations. [1-3] While altered surface texture, hardness, fracture toughness [4] and increased surface roughness of enamel[5] have been reported, some studies have shown little or no effect on the physical properties of enamel.[6,7] Hydrogen peroxide which has been suspected to cause denaturation of proteins in the organic components of dentin and enamel [8] reduces microhardness values [9] and results in changes in the mechanical properties of dentin [4] and can reduce the bond between resin restorations and dental tissues. [10] It is suggested that dentin is more affected by hydroxide base materials due to its less mineral content and more organic matrix. [11]

The success of composite restorations depends on bonding them to hard tooth tissue that would retain the restoration in the cavity preparation and prevent microleakage. [11] The dental adhesives used in dentistry have different tooth-composite interface morphologiyes [12,13], different bond strengths and [14,15] different abilities in microleakage prevention.[16] So, the bonded interfaces may be affected by the bleaching agents differently. [17] Clearfil SE Bond is a two-step adhesive with PH=2.

Despite the lower acidity, acceptable bond strength in enamel samples was obtained. Of course, Laboratory results were shown the favorable application of adhesive on the enamel. [17] Perdigão et al. have investigated the effects of preoperative bleaching on microleakage and sealing ability of tooth colored restorative materials.[18]

They found that bleaching will alter the protein and mineral content of the enamel, which may be responsible for reduced bond strength and increased microleakage. Some researchers also have studied the

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effect of bleaching agents on the microleakage of existing restorations [19-22] reported that bleaching has adverse effect on the sealing ability of the existing composite restorations where as Klukowska et al and White et al showed that bleaching had no influence on the microleakage of composite restorations. [23,24] The purpose of this experimental study was to evaluate the effect of different concentrations of CP on the microleakage of existing composite restorations treated with self-etch adhesive systems**.**

Materials&Methods

A total of 24 non-carious freshly extracted human molars were used in this study. These teeth were cleaned and stored in 0/5% chloramine T solution for 24 hours at room temperature. Teeth were scal after being cleaned with a rubber cup and slurry of pumice. Standard class V cavities (3×2×2 mm) were prepared on the buccal & lingual surfaces at the cemento-enamel junction with the incisal margins in enamel and the gingival margins in dentin.

The enamel margin was bevelled with a carborundum point bur (Shofu, Kyoto, Japan). All cavities were etched with 37% phosphoric acid (Ivoclar Vivadent, Schaan, Lichtenstein), 30 seconds for enamel and 15seconds for dentin. Then, the prepared cavities were rinsed with water and air dried. After that, clearfil SE Bond adhesive (Kuraray, japan) was applied with a microbrush (according to the manufacturer´s instructions).

The cavities were incrementally restored with a light curing composite material, (Filtek Z250 3M ESPE, St.Paul, MN, USA), and cured for 40 seconds (LED/ Ultradent products Ins, UT, USA).

Polishing and finishing of the samples were conducted with Sof- Lex polishing disks (3M ESPE, St. Paul, MN, USA). Samples were stored in artificial saliva (Hypozadix, France, Biocodex) (pH= 7.4) for 24h, and thermocycled for 500 cycles between 5±2°C and 55±2°C with a dwell time of 30S for each and a transfer time of 10S (Mp Based, KARA 1000, Tehran, Iran). Samples were randomly divided into 4 groups (n=12). The bleached groups' teeth were bleached with a vital bleaching protocol using 10%, 22% and 35% CP gel (white smile, Germany) by immersion for 8 hours/day during 14 days.

Group one: Control, No bleaching was performed on the samples.

Group two: The teeth were bleached with 10% CP gel (white smile, Germany) for 8 hours/day during 14 days.

Group three: The teeth were bleached with 22% CP gel (white smile, Germany) for 8 hours/day during 14 days.

Group four: The teeth were bleached with 35% CP gel (white smile, Germany) for 8 hours/day during 14 days.

Teeth were dried and covered with two coats of nail varnish, with the exception of 1 mm around the tooth-restoration interface .Apical foramen of the teeth was sealed using sticky wax. Next, the samples were immersed in 0.5% Basic fuchsin dye for 24hr. Teeth were stored in artificial saliva at all times except during the bleaching process, thermocycling and dye penetration testing. Then, the teeth were longitudinally sectioned in a buccolingual direction using a cutting machine (Dentarapid, Krupp Dental 759 DR 2, Hilzingen, Germany). Dye penetration was determined under a stereomicroscope (Meiji Techno Co, Tokyo, Japan) at ×40 magnification and defined according to the following scoring scale.[25]

0: no dye penetration

1: Dye penetration less than ½ of the gingival floor (from margin to ½ of the gingival floor)

2: Dye penetration more than ½ of the gingival floor (from ½ of the gingival floor up to the axial wall)

3: Dye penetration along the axial wall

Statistical analysis was carried out using the Kruskal-Wallis to determine any significant differences in microleakage scores among the groups. Comparison of the groups with each other were performed with Mann-Whitney u-test and ANOVA. P value less than 0.05 was considered significant.

Results

There was a significant difference in microleakage scores of the control group (No bleaching) and the three bleached groups along the gingival wall ($P<0.001$) while the differences between bleached groups (10%, 22% and 35%) were not statistically significant ($P>0.05$).

Microleakage in the bleached group with 22% CP gel was less than other groups, but this difference was not significant ($p>0.05$). Table 1 shows the Frequency (%) of microleakage in all groups.

According to the results of the present study, the bleaching material had a significant effect on the marginal seal of the resin composite after 14 days of

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bleaching. Degrees of microleakage for gingival wall are presented in figures 1.

Table1. Frequency (%) of microleakage in studied groups

Microleakage	0 N (%)	1 N (%)	2 N (%)	3 N (%)	Mean Rank
Control	7 (58.3)	4 (33.3)	1 (8.3)	0 (0)	7.29[a]
10%	0 (0)	0 (0)	5 (41.7)	7 (58.3)	32.29[b]
22%	0 (0)	0 (0)	8 (66.7)	4 (33.3)	27.67[b]
35%	0 (0)	0 (0)	6 (50)	6 (50)	30.75[b]
					P<0.001

*Same letters in same column were not significantly different (p>0.05)

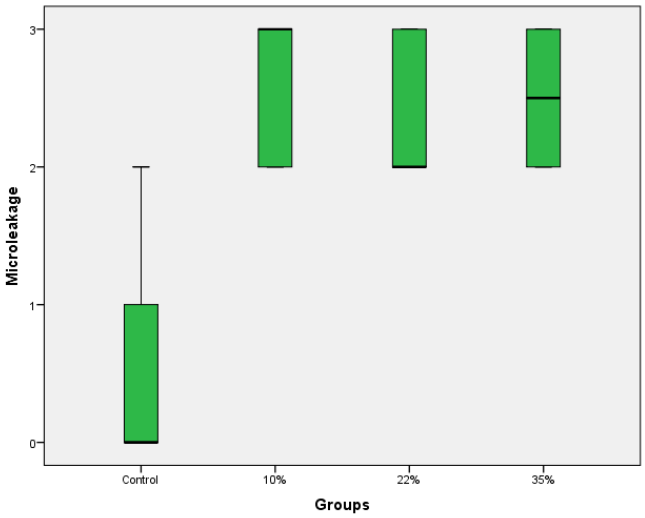


Figure1. Micro leakage degrees of the control and bleached groups at the gingival margins

Discussion

According to the results of the present study, bleaching with different concentration of carbamide peroxide (group 2, 3 and 4) resulted significant increase in the microleakage compared to the unbleached group (Control group or group 1). The results of Klukowska et al and White's et al studies are inconsistent with the results of our study.[23,24] They concluded that Bleaching agents do not affect the microleakage of composite restorations bonded with scotch bond, however a number of studies have shown that the bleaching agents are effective on microleakage of composite restorations. Ulukapi et al and Turkun et al, found that non-vital bleaching with 10% CP can increase the score of microleakage in the composite restorations' margins. [21,24]

Also Moosavi et al. concluded that bleaching with CP after restoration can increase the microleakage in dentin margins of the composite restorations. [22] Roubickova et al. Stated that bleaching can cause a significant change in the microleakage of composite restorations. [25] These findings are in accordance with our study. The possible reason for the dye penetration in all groups is due to the dimensional changes of the resin material adhered to the cavity walls. These include the polymerization shrinkage of composite resin, the difference in thermal expansion coefficient between the tooth-resin composite material and hygroscopic adsorption. [26]

Because the resin's thermal expansion coefficient is quadruplicate of the tooth structure, temperature changes over time cause the marginal leakage in any composite restorations attached to the tooth. In clinical conditions, it is possible to compensate the shrinkage of composite resins and residual stresses by liquid absorption. [27] The use of CP can cause denaturation of proteins in inorganic compounds of the enamel and dentin. The microhardness reduction is a result of changes in the mechanical details and can reduce the bond between resin and teeth.[28]

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Dentinal margins may be more affected by bleaching agents when self-etching adhesive system is used. These effects may be due to less mineral content and more organic matrix of dentin. Bleaching agent may denature dentin proteins, resulting in morphological changes that could reduce the bond between resin restorations and dentin. The exposure of dentin to bleaching agents reduces microhardness values and the alterations in dentinal organic/inorganic composition may also result in changes in mechanical properties of dentin that may make it more prone to be affected by bleaching agents. [29] Another important factor in the microleakage is the durability of dentin-resin bond. [30]

Biological interface between the restoration and the underlying structure of the teeth determines the clinical success of dental restoration. Many studies have shown the problem of resin adhesion to dentin margins in comparison to enamel margins. [17,30] The degradation of resin components within the adhesive layer, in addition to resin leaching result in enlarged marginal voids that might allow bacterial leakage. The release of metabolic products by bacteria damages the dentin-resin interface. Chemical analysis of the interface can progress further. [30,31]

Resin-dentin bond is formed from infiltration of resin to a demineralized dentin matrix. Mechanical stability depends on the stability of: 1-component adhesive bonding 2- Collagenous matrix of the Hybrid layer. Anything that undermines each of these components reduces the mechanical properties of bonding. [32] Many studies have been done on a variety of adhesives. In a study conducted by Yazici et al., Increased leakage in the Etch-and-Rinse (Single Bond [SB]) and Self-Etch Adhesives (Coat [OC]) was observed. [31] Bektas et al. studied two kinds of adhesive systems. They concluded that bleaching with CP gel significantly increased the leakage in dentin walls of the composite resin restorations, bonded with Prompt l-pop self-etch adhesive, but had no effect on the restorations of Scotch Bond Multi Purpose Group.[32]

The results of dentin adhesives with more hydrophilic properties are poor. Studies have shown higher water absorption in resin, softening polymer and reducing its strength and stiffness. The strength and durability of resin-dentin bond reduce over time. [32]

Microleakage in the bleached group with 22% CP gel was less than other groups, but this difference was not significant ($p>0.05$). No study has found to investigate different concentration of CP on the microleakage of composite restorations. This finding of our study can attributed to low adverse effect of 22% CP gel on structure of dentine, CP gel's composition and application method.

Overall, based on this study results, all of three concentration of CP (10%, 22% and 35%) had a significant effect on marginal seal of composite restorations.

Conclusion

Under the condition of this study:

1. Post operative bleaching could increase the microleakage scores of composite restoration's gingival wall, treated with clearfil SE Bond selfetch adhesive.
2. There wasn't a significant difference in microleakage scores of the three concentrations of CP (10%, 22% and 35%).
3. Post operative bleaching in composite restorations treated with clearfil SE Bond self-etching adhesive does not recommend.

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Conflict of interest: There was no conflict of interest.

Authors 'Contributions

The study was designed by Fariba Ezoji and Farnoosh Nikkhah. The study data were collected by Shaghayegh Sadeghloo. Results were evaluated by Hemmat Gholinia. Analysis and interpretation of data, drafting of the manuscript and critical revision of the manuscript for important intellectual content were pre-formed by Hemmat Gholinia, study supervision was performed by Fariba Ezoji.

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