International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319 – 6505, Impact Factor: SJIF: 5.995
Available Online at www.journalijcar.org
Volume 6; Issue 9; September 2017; Page No. 6223-6226
DOI: http://dx.doi.org/10.24327/ijcar.2017.6226.0898

Research Article

AN INVITRO EVALUATION OF ALCOHOL FREE AND HERBAL MOUTHRINSES ON MICROLEAKAGE OF CLASS V COMPOSITE RESIN RESTORATIONS WITH SELF ETCH ADHESIVE SYSTEMS AFTER BLEACHING WITH CARBAMIDE PEROXIDE

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A R T I C L E I N F O

Article History:

Received 16th June, 2017
Received in revised form 3rd July, 2017 Accepted 18th August, 2017
Published online 28th September, 2017

Key words:

Adhesive system, Adper easy one, Bleaching, Microleakage, Mouthrinse.

A B S T R A C T

Aim: The aim was to evaluate the effect of Colgate Total advanced proshield mouthrinse (Colgate) and Hiora herbal (Hiora) mouthrinses on microleakage of composite resin restorations bonded with two adhesive systems after bleaching with 22% carbamide peroxide.

Materials and methods: A total of 96 Class V cavities were prepared on human premolars. The occlusal and gingival margins were placed 1 mm occlusal to and apical to CEJ respectively. The teeth were randomly divided into two groups based on the adhesive system used: Adper Easy One (ADP) and Clearfil SE Bond (CSE) groups. After composite resin restoration of cavities, thermocycling and bleaching with 22% carbamide peroxide for 4 hours daily for a period of 3 days, the teeth in each adhesive group were further subdivided into two subgroups and were immersed for 12 hours in colgate and hiora mouthrinses. The teeth were then placed in 2% basic fuschin for 24 hours, dissected and microleakage was evaluated under a stereomicroscope at 40×. Data was analyzed with chi^2 test and posthoc tukey's test at $p < 0.05$.

Results: Microleakage with ADP was significantly higher than that with CSE ($p = 0.041$). Microleakage at gingival margins was significantly higher than that at occlusal margins. Microleakage with Colgate was higher than that with Hiora in both groups I ($p = 0.013$) and II ($p=0.001$).

Conclusion: In the present study, microleakage of composite resin restorations was influenced by the type of the adhesive system, mouthrinse type and the location of the cavity margin.

Clinical significance: Use of some mouthrinses, such as colgate total advanced proshield after bleaching can increase post restoration microleakage of resin composite restorations bonded with adper easy one bonding agent.

INTRODUCTION

Never has science witnessed such a turmoil where every minute detail in restorative dentistry is literally scanned, dissected, pondered over, and then analyzed.[1] There is a revolution in the field of esthetic dentistry, particularly composite resins being a growing concern to every clinician which is evaluated to the deepest core. Although the physical and mechanical properties of composite resins have improved, polymerization shrinkage remains one of the major concern leading to failure of direct composite resin. Development of self etch adhesives has attracted considerable interest, because these materials simplify the clinical application procedure without compromising the bond strength and retention in the restoration. Self etch adhesives are less time consuming, less technique sensitive, easier to achieve an acceptable seal.[2]

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The use of bleaching agents containing peroxide to bleach vital teeth has become very popular because of long-term clinical success and high patient satisfaction. Since, bleaching agents are in contact with tooth structures for a long time and there is a possibility of their inadvertent contact with dental materials, evaluation of the effect of these products on tooth structures and dental materials has attracted a lot of attention.[2]

Improved understanding of the infectious nature of dental diseases has dramatically increased interest in chemical methods of plaque control and holds great promise for advances in disease control and prevention. However, frequent use of mouthrinses may have detrimental effects on oral and dental tissues. So, it becomes very important to establish the effect of these mouthrinses on the restorations being placed especially composite resin restorations which require meticulous maintenance.

Hence this study was designed to evaluate the combined effect of mouthrinses and bleaching agent on the microleakage of recently introduced nanohybrid composite resin restorative materials bonded with self etch adhesives.

Aim

To evaluate the effect of Alcohol free and Herbal mouthrinses on the microleakage of class V composite resin restorations treated with Adper Easy One and Clearfil SE Bond self etch adhesives following treatment with 22% carbamide peroxide.

MATERIALS AND METHODS

A total of 48 maxillary premolars that were satisfying inclusion criteria of the study were collected and stored in 0.1 % w/v thymol solution. They were cleaned thoroughly to remove hard and soft tissue debris by using an ultrasonic scaler.

Inclusion criteria for the teeth to be evaluated in the study

1. Anatomically and morphologically well defined teeth.
2. Non carious maxillary premolar teeth with intact tooth structure, extracted for orthodontic purpose.

Class V cavities were prepared on both buccal and lingual surfaces of each tooth using a straight fissure diamond point in a high speed hand-piece with air and water coolant. The cavities were made with the following dimensions: Mesiodistal length: 3 mm, cavity depth: 2 mm and cavity occlusogingival width: 2 mm to place the cavity at 1 mm occlusal to the CEJ and 1 mm gingival to the CEJ. All the cavity margins were butt jointed without any bevels and the bur was replaced after preparation of 8 cavities. The prepared teeth were rinsed and stored in distilled water until restored.

The teeth were randomly divided into two groups (n = 24) based on the adhesive system used. In group I, Adper Easy One self etch adhesive and in group II, Clearfil SE Bond adhesive resin were applied on cavity walls according to manufacturer instructions. Then, the cavities of both groups were restored horizontally in two increments with shade A1 Filtek Z250 XT composite resin.

After restorative procedures, all the samples were polished with diamond polishing burs and polishing disks. Subsequently the specimens were stored in distilled water at 37°C for 24 hours.

To simulate oral conditions the specimens underwent a thermocycling procedure consisting 500 cycles at 5 ± 2°C/55 ± 2°C with a dwell time of 30 seconds and 10 seconds for specimen transfer.

Group I specimens (n=24) were randomly divided into four sub groups each with six specimens as follows.

Sub group-I A: Cavities were restored with shade A1 Filtek Z250 XT composite resin (Nanohybrid composite).

Sub group-I B: Similar procedure was repeated as described in sub group-I A, then teeth were dried and bleached with 22% Carbamide peroxide gel was applied for 4 hours per day for a period of three days. After 4 hours the bleaching gel was completely rinsed off from the surface with distilled water. All the samples were stored in artificial saliva during the time between the successive bleaching sessions. Sub group-I C and D: Similar procedure was repeated as described in sub group-I B, then the teeth were immersed in Colgate Total Advanced Pro-Shield mouthwash and Hiora mouthwash respectively.

Similar procedure was repeated with Group II samples also.

The restored teeth were placed in 20ml of the test solution contained within a glass flask for 12 hours, which was reported as the equivalent time to 1 year using of mouthwash as 2 minute daily. The bottles were shaken every 1hour for 30 seconds to provide homogeneity. After 12 hours, the samples were removed, and rinsed, then they were stored in artificial saliva. The teeth were then immersed in 2% basic fuchsin solution at 37 ° C for 24 hours, sectioned buccolingually and examined under a Stereomicroscope at 40X magnification. The degree of micro leakage at occlusal and gingival margins was graded by a single operator according to the scale given by Khera and Chan[3]

1. No dye penetration
2. Dye penetration up to less than half the cavity depth
3. Dye penetration more than the half cavity depth, without axial wall involvement

Table 1 Comparison of frequency and percentage distribution of microleakage scores at occlusal and gingival walls for Groups I and II using Chi square test

GROUPS	BONDING AGENT	LOCATION	SCORE		CHI^2 VALUE	P VALUE
			ACCEPTABLE	UN ACCEPTABLE		
CONTROL	ADP	OCCLUSAL	11 (91.7%)	1 (8.3%)	3.556	.059
		GINGIVAL	7 (58.3%)	5 (41.7%)		
	CSE	OCCLUSAL	12 (100.0%)	0 (0.0%)	1.043	.307
		GINGIVAL	11 (91.7%)	1 (8.3%)		
BLEACHING	ADP	OCCLUSAL	11 (91.7%)	1 (8.3%)	13.594	.000
		GINGIVAL	2 (16.7%)	10 (83.3%)		
	CSE	OCCLUSAL	9 (75.0%)	3 (25.0%)	0.202	.653
		GINGIVAL	8 (66.7%)	4 (33.3%)		
COLGATE	ADP	OCCLUSAL	4 (33.3%)	8 (66.7%)	4.800	.028
		GINGIVAL	0 (0.0%)	12 (100.0%)		
	CSE	OCCLUSAL	2 (16.7%)	10 (83.3%)	0.000	1.000
		GINGIVAL	2 (16.7%)	10 (83.3%)		
HIORA	ADP	OCCLUSAL	11 (91.7%)	1 (8.3%)	10.971	.001
		GINGIVAL	3 (25.0%)	9 (75.0%)		
	CSE	OCCLUSAL	10 (83.3%)	2 (16.7%)	4.444	.035
		GINGIVAL	5 (41.7%)	7 (58.3%)		

Statistical analysis

Statistical analysis was performed using the statistical package for the social sciences (SPSS), version 17.0 (SPSS Inc., Chicago III). Data was analyzed with chi^2 test and posthoc tukey's test at $p < 0.05$.

RESULTS

Table 1 shows the frequency and percentage distribution of microleakage scores at occlusal and gingival walls for Groups I and II using Chi square test. The Chi square value indicates that there was a statistically significant difference between the occlusal and gingival walls in Groups IA, IB, IC, ID and IID. Results showed that in all groups, microleakage scores were higher at gingival margins compared to occlusal margins except in Group II C (Clearfil SE Bond-Colgate).

Table 2 shows that, there was no statistically significant difference between all the groups except for the control group (p=.041).

Table 2 Intergroup comparison of microleakage scores using Chi square test

Groups	Bonding Agent	Score		CHI^2 Value	P Value
		Acceptable	Unacceptable		
Control	ADP	18 (75.0%)	6 (25.0%)	4.181	.041
	CSE	23 (95.8%)	1 (4.2%)		
Bleaching	ADP	13 (54.2%)	11 (45.8%)	1.422	.233
	CSE	17 (70.8%)	7 (29.2%)		
Colgate	ADP	4 (16.7%)	20 (83.3%)	.000	1.000
	CSE	4 (16.7%)	20 (83.3%)		
Hiora	ADP	14 (58.3%)	10 (41.7%)	.087	.768
	CSE	15 (62.5%)	9 (37.5%)		

The mean difference is significant at the 0.05 level.

Table 3 shows multiple group comparisons using Tukey's HSD test.

Table 3 Pairwise multiple comparison tests to determine the increase in microleakage between the groups bonded with Adper easy one self etch adhesive using Tukey's HSD posthoc analysis

Multiple Comparisons: Tukey's HSD						
Dependent Variable		Mean Difference (I-J)	Std. Error	Sig (p value)	95% Confidence Interval	
					Lower Bound	Upper Bound
Control (IA)	Bleaching (IB)	-.20833	.13333	.405	-.5572	.1405
Control (IA)	Colgate (IC)	-.58333*	.13333	.000	-.9322	-.2345
Control (IA)	Hiora (ID)	-.16667	.13333	.597	-.5155	.1822
Bleaching (IB)	Colgate (IC)	-.37500*	.13333	.030	-.7239	-.0261
Bleaching (IB)	Hiora (ID)	.04167	.13333	.989	-.3072	.3905
Colgate (IC)	Hiora (ID)	.41667*	.13333	.013	.0678	.7655

The mean difference is significant at the 0.05 level.

By the above test, it can be concluded that there was no statistical significant difference between Group I A (Control) and Group I B (Bleaching) (p=0.405).

There was a significant difference between Group I A (Control) and Group I C (Colgate mouthrinse) (p=0.000).
There was no statistical significant difference between Group I A (Control) and Group I D (Hiora mouthrinse) (p=0.597).
The difference was also significant between Group I B (Bleaching) and Group I C (Colgate mouthrinse) (p=0.030).
There was no statistical significant difference between Group I B (Bleaching) and Group I D (Hiora mouthrinse) (p=0.989)

There was a significant difference between Group I C (Colgate mouthrinse) and Group I D (Hiora mouthrinse) (p=0.013).

DISCUSSION

Advancements in science and dental materials have led to the paradigm shift in today's life in the way teeth are restored.[4]
The risk of marginal failure due to degradation of the adhesive interface by oxygen radicals is particularly relevant for self etch systems, which are prone to increased water sorption and thus may be more susceptible to the penetration of small oxygen molecules than are etch and-rinse systems. Peroxide-induced degradation of the adhesive interface, however, has not yet been fully elucidated.[5]

Inconsistent results in the literature may be due to the different adhesives and bleaching systems studied, differences in bleaching protocols, and the various test methods employed, including, typically, bond strength and microleakage measurements. To clarify some of these discrepancies, the effect of bleaching on marginal integrity was evaluated in this study using self etch adhesives and peroxide bleaching gel. The use of mouthrinses with high alcohol content increases the risk of oropharyngeal cancer and alcohol-free mouthrinses tend to cause less patient discomfort than those containing alcohol. In view of the aforementioned and the fact that alcoholic mouthrinses tend to degrade composite and compomer restoratives, the alcohol free mouthrinse was used in this study.[6] Scientists have diverted their interest to phytochemistry and thus herbal medicine. Hence in the present study, the effect of alcohol free and herbal mouthrinses on composite resin restorations after bleaching was evaluated.[7]

The bonding agents employed in the present study were Adper Easy One(ADP) and Clearfil SE Bond (CSE) which are one step and two step self etch adhesives respectively. Microleakage with ADP was significantly higher than that with CSE (p = 0. 041).

Clearfil SE Bond adhesive contains the acidic monomer 10-MDP (10-methacryloxydecyl dihydrogen phosphate), which was found to adhere to HAp most readily and intensively. 10-MDP includes two hydroxyl groups in its chemical structure and is able to chemically bond to dental tissue by chelation with calcium more easily and with a higher bond strength value.[8] MDP in the bonding resin would deionize by using

intrinsic water in dentin, and potentially interact with dentin more intensely at deeper depth (0.8-1.2μm). Further, by the addition of MDP, the hydrophilicity of bonding resin would be improved, enabling the penetration of the bonding resin into primer-treated dentin.[9]

Another important finding of the present study was that microleakage scores in both systems were higher at gingival margins compared to occlusal margins. In Group I, the higher microleakage scores at gingival margins compared to occlusal margins might be attributed to differences in the chemical composition of these two margins. The higher leakage observed at the cervical margin may be related to the absence of dentin tubules in the limiting 100 μm of the cervical margin and the mainly organic nature of the dentin substrate. Enamel, when present at the cervical margin, is usually thin, prismless and less amendable to bonding. When polymerized, the composite resin contracts toward the superior bond at the occlusal margin and away from the weaker bond at the gingival margin.

The results also showed that there was no statistically significant difference in microleakage between the control groups and the groups treated with 22% carbamide peroxide bleaching agents (Group I, p = 0.405 and Group II, p =0.144). This may be due to the shorter application periods of the bleaching agent (4- hour periods per day for 3 days) and the samples were stored in artificial saliva for 14 days after the bleaching procedures. The saliva might have interacted with enamel, possibly reducing the negative effects of the applications.

The mouthrinses employed in the present study were Colgate Total advanced proshield (alcohol-free) and Hiora herbal mouthwash which represented the wide range of commercial products available on the market. In Group I, there was a statistically significant difference between subgroup I A (Control) and subgroup I C (Colgate Total advanced proshield mouthrinse) (p =0.000), amongst which subgroup I C showed higher microleakage values. There was no statistical significant difference between subgroup I A (Control) and subgroup I D (Hiora mouthrinse) (p =0.597). Microleakage was higher after immersion in Colgate Total advanced proshield mouthrinse compared to Hiora mouthrinse (p =0.013).

In Group II, there was a significant difference between subgroup II A (Control) and subgroup II C (Colgate mouthrinse) (p =0.000), subgroup II D (Hiora mouthrinse) (p =0.026), amongst which subgroup II C and IID showed higher microleakage values. There was a significant difference between subgroup II C (Colgate mouthrinse) and subgroup II D (Hiora mouthrinse) (p =0.001) with subgroup II C showing higher microleakage.

In the present study, higher microleakage values with Colgate Total advanced proshield mouthrinse might be attributed to the presence of cetylpyridinium chloride (CPC) in its chemical composition. CPC is a cationic surfactant, which can reduce surface tension of the liquid and decrease intersurface tension between a solid (gap walls here) and a liquid (basic fuchsin), resulting in an increase in wetting and penetration coefficient into the capillaries (gaps here).[2]

Furthermore, the low pH of Colgate Total advanced proshield mouthrinse (pH=3.88) may have acted in the polymeric matrix of the nanofilled resin composite used in the study, through catalysis of ester groups from dimethacrylate monomers present in the composition (Bis GMA, Bis EMA, UDMA and TEG DMA. The hydrolysis of these ester groups may have formed alcohol and carboxylic acid molecules that may have accelerated the degradation of the resin composite.[10]

Based on the limitations of the present laboratory research, it is also recommended that microleakage evaluations be carried out with more accurate techniques with more cross-sections using electron microscopes for the evaluation of composite resin tooth structure interface in future studies.

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