Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2018;7:2:28-33.

The Effects of Three Different Cavity Disinfectants on the Sealing Ability of 7th Generation Dentin Bonding Agent

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ABSTRACT

Aim: This study was performed to determine the effect of three cavity disinfectants Bisco (2% chlorhexidine), Tubulicid Red (EDTA, Benzalkonium chloride, 1%NaF), 2%Iodine, on the sealing ability of 7th generation dentin bonding system Adper Easyone.

Materials and method: Class V cavity was prepared on human extracted premolars. Cavity disinfectant was applied on the prepared cavity, followed by the dentin bonding agent and restored with composite. After that teeth were subjected to 1,000 thermal cycles between water baths of 5° C-55° C, with a dwell time of 30 seconds, followed by dye leakage test (India ink). Finally teeth were sectioned mesiodistally and buccolingually, and then observed under stereomicroscope to access microleakage.

Results and Conclusion: it can be concluded that Tubulicid Red is best cavity disinfectant as it does not interfere with the sealing ability of the 7th generation dentin bonding system and shows minimum microleakage.

Keywords: Cavity disinfection; Tubulicid Red; chlorhexidine; iodine; microleakage; self-etching adhesives.

INTRODUCTION

Success of restorative dentistry depends on total removal of infected structure and achievement of perfect marginal seal [1]. Procedures for treating caries to eliminate all cariogenic microorganisms from the residual tissues leave an amorphous layer of microcrystalline cutting debris on the enamel and dentin surface known as smear layer. However, according to Pashley [2] the smear layer does not prevent the ingress of bacterial toxins and by products that could lead to pulpal inflammation.

Historically, it was considered that dentin should be sterilized before the placement of any restorative material. The rationale was to eliminate the residual microorganisms in order to prevent the potential propagation of caries[3].

Nowadays, it is recommended to use an antibacterial cavity cleanser after cavity preparation to eliminate the potential risks due to bacterial activity. Previous studies [4-6] depict that a number of antibacterial solutions such as chlorhexidine, sodium hypochlorite, fluoride based solutions and benzalkonium chloride can be used as cavity disinfectants to eliminate residual bacteria from prepared cavities. The use of Tubulicid, a benzalkonium chloride-based disinfectant has also been proposed for disinfecting the cavity preparation, prior to restoration. The Tubulicid Red used in this study contains ethylene diamine tetra-

Received: Sept. 24, 2017: **Accepted:** Nov. 2, 2017
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pISSN 2278-0076
eISSN 2321-9270

acetic acid (EDTA) for the removal of smear layer and benzalkonium chloride which has an antibacterial effect.

Most of the current generation disinfectants contain 2% chlorhexidine gluconate as the primary active ingredient, which is an antiseptic having a wide spectrum of action. Bisco used in this study contains 2% chlorhexidine gluconate and has been reported to have better antimicrobial activity [5].

Several studies [7] have shown that 2% Iodine disclosing/disinfecting solution (I_2 DDS) has been used to disclose and kill bacteria in plaque, hence working as "toilet" for caries removal. Based on this bactericidal effect, I_2 DDS could be an appropriate agent to clean and disinfect dentin and enamel substrates prior to restorative procedures.

Now-a-days the use of 7th generation dentin bonding system has increased to a large extent due to its less technique sensitive, ease of application and less chair side time. Very few studies [8] have been documented regarding the effects of cavity disinfectants on the sealing ability of the 7th generation dentin bonding system. The purpose of this study is to evaluate the effects of three cavity disinfectants (Bisco, Tubulicid Red and 2% Iodine) on the sealing ability of the 7th generation dentin bonding system (Adper Easyone).

MATERIALS AND METHOD

Forty five extracted human premolars free of cracks, caries and restorations on visual inspection, were used for this study. Then class V cavity preparations were prepared on the facial and lingual surfaces of each tooth using high speed airotor handpiece and cylindrical diamond bur, under water-spray coolant. Standardized preparations were obtained by making cavity preparations that were approximately 2 mm wide, 1.5 mm deep and 3 mm long parallel to the cemento-enamel junction (CEJ). The gingival half of the preparation was extended 1 mm below the CEJ. Each preparation was rinsed with distilled water for 20 seconds and dried with compressed air for 20 seconds.

All the specimens were randomly divided into five groups (table 1) group I Bisco, group II Tubulicid Red, group III 2% iodine, group IV negative and group V positive control. I to IV group divided into 20 preparations and group V divided into 10 preparations. After application of cavity disinfectant 7th generation dentin bonding agent was applied and then restored with composite restorations. The specimens without cavity disinfectant application served as the negative controls and the specimens in which neither disinfectant nor dentin bonding system was applied, served as positive controls.

Table 1: Experimental groups used in the study.

GROUPS	DISINFECTANT TREATMENT	DENTIN BONDING SYSTEM
I	BISCO	ADPER EASYONE
II	TUBULICID RED	ADPER EASYONE
III	2% IODINE	ADPER EASYONE
IV*	NONE	ADPER EASYONE
V+	NONE	NONE

*- Negative Control, +- Positive Control

Table 2: Composition of Cavity Disinfectants used in the study.

Product	Active Ingredient	Manufacture
Bisco	2% Chlorhexidine Gluconate	Schamburg, USA
Tubulicid Red	0.1% Benzalkonium Chloride,0.2% EDTA, 1% NaF	Dental Therapeutics AB, Sweden
2% Iodine	2% Iodine	Pansilla Impact, Jabalpur

In the respective test groups, cavity disinfectant was applied with a sterile brush applicator for 20 seconds and then dentin bonding system (Adper Easyone) was applied and cured by using light cure equipment (Coltolux® Curing light, Coltene, USA) according to the manufacturer's instructions. The cavity preparations were then restored with a resin composite (Filtek™ Z 350) in increments. All the restorations were finished and polished, then stored in distilled water for 24 hours at 37°C and subjected to 1,000 thermal cycles between water baths of 5°C and 55°C with a dwell time of 10 seconds. The teeth were then subjected to dye leakage tests.

The root apices of all the specimens were sealed with modelling wax and the teeth were covered with two coats of nail varnish leaving the 1 mm of window around the tooth-restoration margin. The specimens were immersed in India ink (HiMedia, Mumbai) in separate sealable glass beaker at 37°C for 24 hours. After staining, the teeth were rinsed with distilled water in order to remove any residual stain and the radicular parts of the teeth were cut horizontally 4.5 mm below the CEJ. Coronal parts were sectioned mesiodistally and then buccolingually in the approximate center of the restoration with a low speed diamond disc mounted in mandril. Microleakage was assessed for both occlusal (enamel) and gingival (cementum) margins, using a stereomicroscope at a magnification of 16X.

The depth of the stain (dye leakage) was judged according to the following scale: (Turkun M andTurkun S 2004)[9]

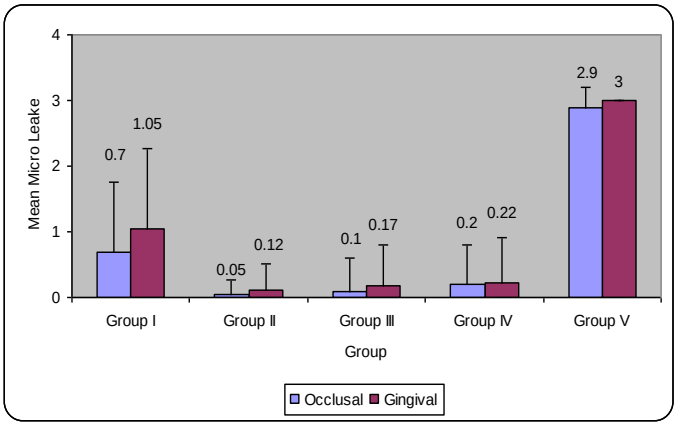
0 – No leakage
1 – Penetration less than one half of the length of occlusal/gingival wall
2 – Penetration greater than one half of the length of occlusal/gingival wall
3 – Penetration up to and along the axial wall
4 – Penetration within the pulp

A nonparametric analysis of variance (ANOVA) test and (Kruskal-Wallis) was used to determine statistically significant differences among the groups. Pair wise comparisons between groups were made using the Mann Whitney Wilcoxon U Test for nonparametric data. Occlusal and gingival margins within the treatment groups were compared using Wilcoxon matched pairs signed rank test. The level of significance was established as $P < 0.05$, for all the tests.

RESULTS

Almost all positive control specimens showed maximal leakage (score3), whereas experimental groups and negative controls exhibited less leakage.

Graph 1: Comparison of Occlusal and gingival margins in group I,II,III,IV, and V.



Kruskal –Wallis test revealed that the differences were highly significant at each (occlusal and gingival) margin ($p<0.05$). There were no statistical significant differences among groups 2, 3 & 4, when pair wise comparison of occlusal and gingival margins were made which revealed that the sealing ability was not interfered with tubulicid red and iodine 2% cavity disinfectants. Mann- Whitney U test compared the occlusal and gingival margins of all the 5 groups that there were no statistically significant differences among groups 2, 3 & 4, whereas statistically significant differences were found between all the experimental groups and both the negative and positive control which suggested that there were marked differences on the sealing ability of tubulicid red and iodine 2% on the one hand and Bisco cavity disinfectant on the other hand.

Wilcoxon Match Pair Signed Rank Test was performed to compare occlusal and gingival margin microleakage and there was no statistical significant difference ($p>0.05$) found among occlusal and gingival margins. However, the occlusal margins showed much less leakage than the gingival margins.

DISCUSSION

The results of this study indicate that application of Tubulicid Red in a prepared cavity applying before Adper Easyone, did not adversely affect its sealing ability. The results are in accordance with a study conducted by Darhami et al (1995)[10], Chew Hew Pin (2003)[11], Murat Turkun (2004)[9] & Vivek Sharma (2009)[12]. Darhami et al[10] showed that treatment of cavity walls with Tubulicid red in place

of original conditioners of adhesive systems had no adverse effect on the sealing ability of dentin bonding resins in class II resin composite restoration.

Benzalkonium chloride contained in Tubulicid red is quaternary ammonium compound and is highly effective disinfectant. It is known to cross link collagen but unlike chlorhexidine this does not seem to impair hybridization. Chew Hew Pin (2003) [11] have found that Tubulicid have no adverse effect on the microleakage of composite restoration when used with dentin bonding agent Prime and Bond NT. Its manufacturer recommended the use of cleanser to be done before etching the cavity. This may be due to EDTA content. EDTA has been shown to remove the smear layer and hence rendering the underlying dentin to the disinfecting action of Benzalkonium chloride. This proves, the surface property and bonding of dentin to resin composite is not affected.

Murat Turkun *et al* [9] also found that the Tubulicid red cavity treatment prior to application of Clearfil SE bond and Prompt L POP did not adversely affect the sealing ability of these dentin bonding systems. The same result was found by Vivek Sharma [12].

In our study I_2 DDS solution also did not adversely affect the sealing ability of Adper Easyone. In 2002 Wahl *et al* [13] tested the effect of different disinfectant rinses and found that the disinfectant water rinse had no significant effect on the shear bond strength of resin dentin bonds. In 2008 S Bansal *et al*[14] had found significantly less microleakage after 5% w/v povidone iodine treatment with Xeno III (self etch adhesive) as compared with PBNT (etch and rinse). These findings were conflicting with other studies Meiers and Cresin [15],

Turkun M [9], Nelson Da Silva [16], Vivek Sharma [12]. Meiers & Kresin [15] (1996) found that Ora-5 produced significantly greater gingival microleakage when used with a two-step self-etch system (Syntac; Ivoclar-Vivadent), but did not increase microleakage with a two-step total-etch system (Tenure; Den-mat).The difference in results found in these studies could be attributed to different bonding substrates used, disinfectants were not rinsed off before bonding and different chemical composition of bonding agents were used.

The presence of statistical difference in our study between the negative control and the experimental group I treated with Bisco before the application of the dentin adhesive systems, in both occlusal and gingival marginal leakage scores, showed that Bisco adversely affected the sealing abilities of Adper Easyone. This finding is in accordance with a study conducted by Tulunoglu [17] (1998), Chew Hew Pin[11] (2003), Mangla *et al*[8] (2011). However, the results of our study are conflicting with another studies Meiers & Kresin (1996)[15], Turkun[9] (2004), F Darabi[1] (2009) & Vivek Sharma [12] (2009).

Chlorhexidine is a broad spectrum antiseptic and its use has been generalized for chemical control of bacterial plaque. Previous studies have demonstrated that chlorhexidine application prior to acid etching in etch and rinse adhesives has no adverse effects on immediate composite adhesive bonds in dentin [18], enamel [19] or with resin reinforced glass ionomer cements[20].

Tulunoglu O et [17] found that the chlorhexidine solution produced significantly higher microleakage when used with Syntac and Prime & Bond. Mamta Singla [8] found that the use of 2% chlorhexidine disinfectant application increased microleakage in single bottle self etch adhesives (Adper Easyone). Self etching adhesives have a pH relatively higher than the phosphoric acid etchants. Scanning electron microscope examination by Meiers and Kresin[15] showed that the application of chlorhexidine cavity disinfectant to dentin surfaces was resistant to acid conditioning. This acid-resistant layer might inhibit the ability of the weak acidic primers to effectively demineralise the dentin and hydrophilic resin to impregnate the dentin surface.

Therefore, it can be concluded from our study that the use of cavity disinfectants with resin composite restorations appears to be material specific, with regard to interaction with the ability of various dentin bonding systems to seal dentin.

CONCLUSION

- Tubulicid Red and 2% iodine can be used as cavity disinfectants with Adper Easyone, without any adverse effect on the sealing ability of Adper Easyone bond.

- 2% chlorhexidine (Bisco) cavity disinfectant increases the microleakage in cavities restored with light cured composites using a single bottle self-etch adhesives. It indicates that it is not an appropriate disinfectant to be used with Adper Easyone.

AKNOWLEDGEMENT

I am extremely thankful to Mr. Daniel Kratt from Dental Therapeutics AB, Sweden, for providing me the cavity disinfectant Tubulicid Red. I am also thankful to Oral Pathology & Microbiology Department of Government Dental College Raipur for giving me permission to use the Steriemicroscope.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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