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A comparative evaluation of shear bond strength of composite resin to the pulp chamber dentin treated with sodium hypochlorite and two different antioxidants: An *in vitro* study

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Abstract
Objective: The effect of 10% sodium ascorbate and 10% pine bark extract on shear bond strength of composite resin to the pulp chamber dentin treated with 3% sodium hypochlorite was evaluated.
Materials and Methods: Thirty extracted mandibular molar teeth were decoronated at the level of cementoenamel junction horizontally to expose pulp chamber floor. The individual tooth was then embedded in self-cure acrylic resin. The specimens were randomly divided into three groups (n = 10). Group A: control group, was treated with 3% sodium hypochlorite (NaOCl) for 30 min followed by a final rinse with 17% ethylenediaminetetraacetic acid (EDTA) solution for 3 min; Group B: after pretreatment with 3% NaOCl and 17% EDTA, it was further treated with 10% sodium ascorbate for 10 min; and Group C: after pretreatment with 3% NaOCl and 10% EDTA, it was further treated with 10% pine bark extract for 10 min. After drying the specimens, a bonding agent was applied to the pulp floor dentin followed by a composite restoration. Specimens were tested under a universal testing machine to determine the shear bond strength. The data obtained were tabulated and statistically analyzed using analysis of variance (ANOVA) and Bonferroni post hoc test.
Results: The 10% pine bark extract group showed highest mean shear bond strength, followed by 10% sodium ascorbate group.
Conclusion: Among the antioxidants used, 10% pine bark extract application showed highest shear bond strength.

Keywords: Antioxidant, pine bark extract, shear bond strength, sodium ascorbate, sodium hypochlorite

Introduction

The purpose of restoring endodontically treated teeth is to prevent bacterial infiltration from the oral cavity, reestablish their functionality and aesthetics, and avoid fracture of the remaining dental structure. However, the prognosis of endodontically treated teeth relies on coronal sealing as well as apical sealing after effective chemomechanical preparation of the root canals. As such, in the past few years, coronal leakage has been extensively demonstrated as a negative contributor to the prognosis of endodontic treatments.[1] Immediate sealing of endodontically treated teeth, using restorative materials, has been reported as a powerful tool in preventing coronal leakage [2].

Composite resin‐based materials have been suggested for the restoration of nonvital teeth [3] because of their benefits such as bonding to dentin by hybrid layer formation and reducing marginal leakage [3, 4] Moreover, teeth restored with resin composite have been shown to exhibit better fracture resistance than those restored with amalgam [3-5] as the physico‐mechanical properties of resin composites are closer to those of dentin [6].

Nevertheless, the structure of dentin surface may change due to the chemical substances used during cleaning and shaping [7] and this in turn may affect the interaction of dentin with adhesive restorative materials [8, 9].

Sodium hypochlorite (NaOCl) has antimicrobial activity and the ability to dissolve organic matter and is therefore widely used as a chemical irrigant for endodontic therapy [10]. The remnants and oxidation by‐products of NaOCl can be one of the reasons due to which there is

a negative effect on the polymerization of dental adhesive systems [11-13]. This adverse effect of NaOCl on the resin–dentin bond strength has been investigated and previously confirmed [8, 9, 11-13] The application of an antioxidant solution before the adhesive procedure could restore the compromised bond strength to NaOCl‐ treated dentin by neutralizing and reversing the oxidizing effect of NaOCl treatment on the dentin surface [2].

Ascorbic acid and its sodium salts are well-known antioxidants that are capable of reducing a variety of oxidative compounds, especially free radicals. In previous studies, it was reported that these antioxidants could reverse the compromising effect of NaOCl and H_2O_2 on the bond strength of enamel and dentin by restoring the altered redox potential of the oxidized bonding substrate. It has been suggested that it would be possible for the compromised bond strength to be reversed by a reduction of the oxidized surfaces with a neutral, biocompatible antioxidant, such as sodium ascorbate, prior to when resin bonding occurs [1].

The interest in natural antioxidants of plant origin has greatly increased in recent years. Oligomericproanthocyanidin complexes present in natural antioxidants like grape seed extract and pine bark extract have free radical scavenging activity [14].

The purpose of this study was to evaluate and compare the shear bond strength of pulp chamber dentin treated with sodium hypochlorite, sodium ascorbate and pine bark extract with the null hypothesis that there is no significant difference existing between tested group.

Materials and Methods

Specimen preparation

Thirty freshly extracted human mandibular molars were used in this study. The teeth were disinfected in o.5% chloramine-T solution and washed under running water, stored in saline and used within 3 months of extraction. All teeth were decoronated at cementoenamel junction using diamond disc (SS White, NJ. USA) [15] All the specimens were then embedded in aluminium mold filled with self-cure acrylic resin [16].

The samples were randomly assigned into three groups of 10 teeth each. All specimens were treated with 3% NaOCl for 30 min, with the solution being renewed every 10 min. The samples were then irrigated and cleaned with saline. Any remaining pulpal tissue was removed with a spoon excavator. After treatment with 3% NaOCl, all the samples were then immersed in a solution of 17% ethylenediaminetetraacetic acid (EDTA) for 3 min. The samples were then irrigated and cleaned with saline.

After this pretreatment of all the samples, they were randomly divided into three groups. Group A (n = 10) was a positive control group which were only treated with 3% NaOCl and 17% EDTA. Group B (n = 10) consisted of samples which were treated with 3% NaOCl and 17% EDTA, and then immersed in a solution of 10% sodium ascorbate for 10 min. Group C (n = 10), consisted of samples which were treated with 3% NaOCl and 17% EDTA, and then immersed in a solution of 10% pine bark extract for 10 min. All the time periods were assessed with a timer.

Bonding procedure

For composite bonding, all specimens were etched with 37% phosphoric acid (3M ESPE Dental Products) for 15 s, rinsed off with deionized water for 20 s, blot dried, and coated with One Coat SL (Coltene, Switzerland) bonding agent using a micro applicator tip (Dentsply) and were cured for 20 s. A teflon mold of 3 mm height and 3 mm diameter was used for composite build up (Filtek Z 250- 3M ESPE, Dental products) on the pulp chamber. Composite resin was build up in increments of 2 mm or less with each increment being light-cured for 40 s using a quartz tungsten halogen light curing unit- Spectrum 800 (Dentsply Caulk, Milford, DE, USA). After the bonding procedure, the samples were stored in distilled water until testing.

Shear bond testing

Each specimen was placed in between the jigs of the universal testing machine (Model 3345; Instron Corp, Canton, Mass, USA) and a pointed shearing rod was placed on the composite resin/tooth interface and was subjected to static loading at a rate of 1 mm/min until fracture occurred. The machine was interfaced with a computer through which the operation was controlled and shear bond strength was calculated.

Statistical analysis

The values obtained were statistically analyzed using computer software Statistical Package for Social Sciences (SPSS) version 16.0. One-way analysis of variance (ANOVA) followed by post-hoc Bon-ferroni test was used to analyze the data. Significance was established at $P < 0.05$ level.

Table 1: One-way ANOVA test:

Shear Bond Strength (MPa)	N	Mean	SD	F	df	P value
Group I (NaOCl+EDTA)	10	4.14	0.857	45.77	2	< 0.001; Highly significant
Group II (Sodium ascorbate)	10	5.97	0.881			
Group III (Pine bark extract)	10	7.94	0.922			
Total	30	6.02	1.794			

Table 2: Post-hoc test: Bonferroni (pair-wise comparisons)

(I) Groups	(J) Groups	Mean Difference (I-J)	SE	P value
Group I (NaOCl+EDTA)	Group II (Sodium ascorbate)	-1.825*	0.39675	< 0.001
	Group III (Pine bark extract)	-3.795*	0.39675	< 0.001
Group II (Sodium ascorbate)	Group III (Pine bark extract)	-1.970*	0.39675	< 0.001

* The mean difference is significant at the 0.05 level

Results

As per one-way ANOVA test, it was observed that the mean shear bond strength was highest in Group III and least in Group I and this difference found was highly significant statistically (p<0.001) (Table no.1). When pairwise comparison was done, it was found that Group I had least shear bond strength as compared to other two groups (Table no.2). Therefore, Group III i.e. Pine Bark Extracts Group has exhibited highest shear bond strength followed by Group II i.e. Sodium Ascorbate Group, followed by Group I i.e. NaOCl+EDTA

Discussion

This study is one of the few emphasizing on evaluation of the resin bond strength to pulp chamber floor dentin after the use of commonly used endodontic irrigant, and it was performed to assess the applicability of sodium ascorbate and pine bark extract to recover the dentin bond strength lost due to chemical oxidative irrigants. The null hypothesis, which considered that sodium ascorbate and pine bark extract would not be effective to recover the compromised bond strength after use of NaOCl was not validated.

NaOCl treatment reduces the mechanical properties of dentin, such as flexural strength, elastic modulus, and microhardness,[17] producing a "new" dentin surface that might be caused by damage to the organic matrix, mainly collagen (Type I) and leaving a porous and mineralized surface.[7] The use of EDTA also contributes to the erosion of this dentin.[7] In addition, NaOCl is an oxidizing substance which causes strong inhibition of the interfacial polymerization of adhesive materials.[18] Thus, there might be some reactive residual‐free radicals in NaOCl‐treated dentin that might compete with the propagating vinyl‐free radicals generated during light activation of the adhesive system, resulting in premature chain termination and incomplete polymerization.[13]

On the other hand, an antioxidant may reverse the NaOCl-compromised dentin bonding. Sodium ascorbate is a derivative of ascorbic acid with a neutral pH. It has been reported that sodium ascorbate is a potent antioxidant capable of quenching the reactive free radicals. It neutralizes the effect on the residual oxygen layer, allows free radical polymerization of resin base materials to proceed without premature termination by restoring the altered redox potential of the oxidized bonding substrate, thus reversing the compromised bonding.[19] So in this study, 10% solution of sodium ascorbate was used.

Pine bark extract contains phenolic compounds broadly divided into monomers (catechin, epicatechin and taxifolin) and condensed flavonoids (oligomeric to polymeric proanthocyanidins).[20] Oligomericproanthocyanidins are a class of polyphenolic bioflavonoids found in fruits and vegetables and are present in grape seed extract, pine bark extract, cranberries, lemon tree bark, hazel nut tree leaves, etc. They have free radical scavenging and antioxidant activity. They also have antibacterial, antiviral, anti-inflammatory, antiallergic, anticarcinogenic, and vasodilatory actions. The presence of the functional group OH in the structure and its position on the ring of the flavonoid molecule determines its antioxidant capacity.[22] The antioxidant properties of grape seed extract and pine bark extract could be due to the flavonoids present.

Shear bond strength test is a simple evaluation procedure used to test the adhesion of dental adhesives. *In vitro* bond strength tests are useful and essential for predicting the performance of adhesive systems and possible correlation with clinical issues. So shear bond strength testing is done with a universal testing machine which is conventionally popular for evaluating the adhesive ability of adhesive/restorative materials.[23]

The results of this study revealed that the pine bark extract group exhibited highest mean shear bond strength corresponding to strongest antioxidant property far more potent than the common antioxidants like vitamins C, E and beta-carotene (Table no.1).

Natural antioxidant used in this study were capable of reversing the compromised bond strength of composite resins to dentin treated with NaOCl. So this could be used to avoid the waiting period before bonding to NaOCl treated dentin which makes it clinically significant. However, this being an *in vitro* study, it cannot mimic the *in vivo* conditions. In the oral cavity, the interface between the restoration and the tooth is exposed to diverse forces that act simultaneously. Shear bond strength of post obturation composite restoration would be influenced by presence of tooth walls, however in this study for standardization only the pulp chamber floor was selected.

Nevertheless, the more expensive and long-lasting clinical trials remain necessary to validate the laboratory observations.[13] Since the results of this study showed a high statistical significant value, it could reproduce clinical significance as well. Further clinical trials are needed to confirm these findings.

Conclusion

Within the limitations of this *in vitro* study, it was observed that among two different antioxidants used i.e. 10% sodium ascorbate and 10% pine bark extract, 10% pine bark extracts exhibited superior antioxidant property in reversing reduced bond strength of composite resin to pulp chamber dentin treated with NaOCl and EDTA.

References

1. Gonulol N, Kalyoncuoglu E, Ertas E. Effect of sodium ascorbate on dentin bond strength after treatment with oxidizing root canal irrigants. J Dent Sci. 2015; 10:139-44
2. Chandrashekhar S, Patil S, Abraham S, Mehta D, Chaudhari S, Shashidhar J. A comparative evaluation of shear bond strength of composite resin to pulp chamber dentin treated with sodium thiosulfate and proanthocyanidin: An *in vitro* study. J Conserv Dent 2018; 21:671-5.
3. Schwartz RS. Adhesive dentistry and endodontics. Part 2: Bonding in the root canal system‐the promise and the problems: A review. J Endod. 2006; 32:1125-34.
4. Ray HA, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restoration. Int Endod J 1995; 28:12‐8.
5. Trope M, Langer I, Maltz D, Tronstad L. Resistance to fracture of restored endodontically treated premolars. Endod Dent Traumatol. 1986; 2:35-8.
6. Coelho CS, Biffi JC, Silva GR, Abrahão A, Campos RE, Soares CJ *et al*. Finite element analysis of weakened roots restored with composite resin and posts. Dent Mater J. 2009; 28:671-8.
7. Moreira DM, Almeida JF, Ferraz CC, Gomes BP, Line SR, Zaia AA *et al*. Structural analysis of bovine root dentin after use of different endodontics auxiliary chemical substances. J Endod. 2009; 35:1023-7.
8. Santos JN, Carrilho MR, De Goes MF, Zaia AA, Gomes BP, Souza‐Filho FJ *et al*. Effect of chemical irrigants on the bond strength of a self‐etching adhesive to pulp chamber dentin. J Endod. 2006; 32:1088-90.
9. Farina AP, Cecchin D, Barbizam JV, Carlini‐Júnior B. Influence of endodontic irrigants on bond strength of a self‐etching adhesive. Aust Endod J. 2011; 37:26-30.
10. Zehnder M. Root canal irrigants. J Endod 2006; 32:389-98.
11. Morris MD, Lee KW, Agee KA, Bouillaguet S, Pashley DH. Effects of sodium hypochlorite and RC‐prep on bond strengths of resin cement to endodontic surfaces. J Endod. 2001; 27:753-7.

12. Erdemir A, Ari H, Güngüneş H, Belli S. Effect of medications for root canal treatment on bonding to root canal dentin. J Endod. 2004; 30:113-6.
13. Lai SC, Mak YF, Cheung GS, Osorio R, Toledano M, Carvalho RM *et al*. Reversal of compromised bonding to oxidized etched dentin. J Dent Res. 2001; 80:1919-24.
14. Subramonian R, Mathai V, Christaine Angelo JB, Ravi J. Effect of three different antioxidants on the shear bond strength of composite resin to bleached enamel: An *in vitro* study. J Conserv Dent. 2015; 18:144-8.
15. Christopher SR, Mathai V, Nair RS, Angelo JM. The effect of three different antioxidants on the dentinal tubular penetration of Resilon and Real Seal SE on sodium hypochlorite treated root canal dentin: An *in vitro* study. J Conserv Dent. 2016; 19:161-5.
16. Bhatia TK, Asrani H, Banga H, Jain A, Rawlani SS. Influence of salivary contamination on the dentin bond strength of two different seventh generation adhesive systems: *In vitro* study. J Conserv Dent. 2015; 18:467-70.
17. Sim TP, Knowles JC, Ng YL, Shelton J, Gulabivala K. Effect of sodium hypochlorite on mechanical properties of dentine and tooth surface strain. Int Endod J. 2001; 34:120‑32.
18. Rueggeberg FA, Margeson DH. The effect of oxygen inhibition on an unfilled/filled composite system. J Dent Res 1990; 69:1652-8.
19. Kimyai S, Valizadeh H. The effect of hydrogel and solution of sodium ascorbate on bond strength in bleached enamel. Oper Dent. 2006; 31:496-9.
20. Kim SM, Kang SW, Jeon JS, Um BH. A comparison of pycnogenol and bark extracts from Pinus thunbergii and Pinus densiflora: Extractability, antioxidant activity and proanthocyanidin composition. J Med Plants Res. 2012; 6:2839-49.
21. Fine AM. Oligomeric proanthocyanidin complexes: History, structure and phytopharmaceutical applications. Altern Med Rev. 2000; 5:144-51.
22. Perumalla AV, Hettiarachchy NS. Green tea and grape seed extracts-Potential applications in food safety and quality. Food Res Int. 2011; 44:827-39.
23. Hegde MN, Bhandary S. An evaluation and comparison of shear bond strength of composite resin to dentin using newer dentin bonding agents. J Conserv Dent. 2008; 11:71-5.