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ORIGINAL ARTICLE

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Effect of natural antioxidants on bond strength recovery of resin-modified glass ionomers to the NaOCl-affected pulp chamber dentin

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Abstract

Objective: This study evaluated the effect of two natural antioxidants on the compromised bond strength of a resin-modified glass ionomer (RMGI) to the sodium hypochlorite (NaOCl)-affected pulp chamber dentin.

Methods: Forty-two sound third molars were split into halves. The exposed pulp chamber dentin was ground to provide the flat dentin surfaces and divided into seven groups ($n = 12$), according to the solutions used for immersion: (1) Control, distilled water; (2) NaOCl, 5.25% NaOCl for 20 min; (3) NaOCl/Ethylenediaminetetraacetic acid (EDTA); 5.25% NaOCl for 20 min + 17% EDTA for 1 min; (4) NaOCl/TA, 5.25% NaOCl + 10% tanic acid (TA) for 5 min; (5) NaOCl/EDTA/TA, 5.25% NaOCl + 17% EDTA + 10% TA for 5 min; (6) NaOCl/PA, 5.25% NaOCl+ 10% proanthocyanidin for 5 min; and (7) NaOCl/EDTA/PA, 5.25% NaOCl+ 17% EDTA + 10% PA for 5 min. The RMGI was bonded on the treated dentin using a Tygon tube. After 24 h of storage, microshear bond strength (μSBS) was tested. Data in MPa were submitted to one-way analysis of variance and Tamhane test.

Results: NaOCl significantly decreased the μSBS; NaOCl/EDTA and NaOCl/TA significantly increased the μSBS, higher than the control group ($p < .05$); and in the NaOCl/EDTA/TA group, the increased bond strength was at the level of the control group ($p > .05$). NaOCl/PA and NaOCl/EDTA/PA and NaOCl groups had comparable μSBS.

Conclusion: TA could be suggested to provide effective bonding of RMGI and immediate sealing of the pulp chamber dentin after NaOCl irrigation.

KEYWORDS

antioxidants, dental pulp cavity, sodium hypochlorite

partially removing the smear layer (Christopher et al., 2016). Also, EDTA with a pH of 7.4 has these capabilities through chemical chelation, not acidity (Fawzi et al., 2010; Hülsmann et al., 2003). In contrast to TA, PA used after NaOCl was not able to restore the μSBS of FLC. Although the prepared PA solution had a slight acidity, its pH was adjusted to 7.2 by adding NaOH to the solution. These findings revealed that the antioxidant activity of PA and TA may have no benefit in the bonding reversal of RMGI to the NaOCl-treated dentin. It seems that the other properties of PA and TA may contribute to the opposite results for TA versus PA. The beneficial effect of EDTA on the NaOCl-affected pulp chamber dentin was reversed by PA application in the NaOCl/EDTA/PA group. PA with a large molecular size and several hydroxyl groups creates a strong bonding to proteins amid the carbonyl group of the collagen fibers via hydrogen ionic, covalent, and hydrophobic interactions (Hass et al., 2016). Furthermore, the hydroxyl groups of PA can create chemical bonding with calcium ions of dentin. Hence, these interactions may lead to interference with the micromechanical and chemical bonding of RMGI.

The two bonding mechanisms of RMGI could contribute to the bond strength of RMGI. However, its chemical bonding is essential to provide bonding durability (Saad et al., 2017). The microspecimens of the FLC-pulp chamber dentin used in this bond strength study could provide suitably bonded microspecimens because they need no further preparation after the initial bonding procedures. This prevents the induction of prestress on the bonding interface before testing.

The null hypothesis tested in this in vitro study has to be partially rejected since TA has been revealed to exert a considerably beneficial effect on the bonding ability of the RMGI to the pulp chamber dentin, whereas PA had no effect.

The present study was performed on the smear layer-covered dentin produced by grinding. This grinding is necessary to provide a flat dentin surface for bond strength testing. However, in the intraoral situation, RMGI was bonded directly on the pulp chamber dentin with no dominant smear layer because it is not prepared during ET (Schellenberg et al., 1992).

The present research was a short-term bond strength study. Further long-term research with different antioxidant/irrigant agents and various application times is suggested to be conducted to evaluate the longevity of the bonding of RMGIs.

In the current vitro study, we have only evaluated the short-term effect of the two antioxidants on the bond strength of RMGI to NaOCl-affected dentin. As the aging process may influence the durability of the bond, long-term investigations with other antioxidant agents by using different application times are suggested. Furthermore, in vivo studies should be conducted before the advisement of antioxidants in clinical procedures.

5 | CONCLUSION

The adverse effect of NaOCl irrigation on the bonding ability of the RMGI to the pulp chamber dentin could be completely recovered by a 5-min application of TA solution. PA was not capable of inducing any reversing effect on the compromised bond strength.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception, design, data acquisition and interpretation, and statistical analysis and drafted and critically revised the manuscript. All authors gave their final approval and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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