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## Research paper

# Long-term stability of dentin matrix following treatment with various natural collagen cross-linkers

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## ABSTRACT

**Objectives:** Collagen disorganization is one of the main degradation patterns found in unsuccessful adhesive restorations. The hypothesis of this study was that pretreatment using natural collagen cross-linking agents rich in proanthocyanidin (PA) would improve mechanical properties and stability over time of the dentin collagen and, thus, confer a more resistant and lasting substrate for adhesive restorations. **Methods:** PA-based extracts, from grape seed (GSE), cocoa seed (CSE), cranberry (CRE), cinnamon (CNE) and açai berry (ACE) were applied over the demineralized dentin. The apparent elastic modulus (E) of the treated dentin collagen was analyzed over a 12 month period. Specimens were immersed in the respective solution and E values were obtained by a micro-flexural test at baseline, 10, 30, 60, 120 and 240 min. Samples were stored in artificial saliva and re-tested after 3, 6 and 12 months. Data was analyzed using ANOVA and Tukey test. **Results:** GSE and CSE extracts showed a time-dependent effect and were able to improve [240 min (MPa): GSE =  $108.96 \pm 56.08$ ; CSE =  $59.21 \pm 24.87$ ] and stabilize the E of the organic matrix [12 months (MPa): GSE =  $40.91 \pm 19.69$ ; CSE =  $42.11 \pm 13.46$ ]. CRE and CNE extracts were able to maintain the E of collagen matrices constant over 12 months [CRE =  $11.17 \pm 7.22$ ; CNE =  $9.96 \pm 6.11$ ; MPa]. ACE ( $2.64 \pm 1.22$  MPa) and control groups immersed in neat distilled water ( $1.37 \pm 0.69$  MPa) and ethanol–water ( $0.95 \pm 0.33$  MPa) showed no effect over dentin organic matrix and enable their degradation and reduction of mechanical properties. **Significance:** Some PA-based extracts were capable of improving and stabilizing collagen matrices through exogenous cross-links induction.

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## 1. Introduction

Lack of marginal seal and decreased bond strength of adhesive restorations affects the longevity of restorations

placed in enamel and dentin (Monticelli et al., 2008). Current clinical evaluations attest that continuous degradation of the dentin–resin bond prevails for several bonding systems and can also lead to an increase in the loss rates of restorations

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