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Shortening of primary dentin etching time and its implication on bond strength

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Summary *Objective*. The aim of this study was to investigate the influence of shortening the etching time on the bond strength of a conventional and a self-etching primer adhesive system used in primary tooth dentin.

Methods. Flat dentin surfaces were obtained from 24 primary molars, randomly assigned to 4 experimental groups. The adhesive systems Single Bond and Clearfil SE Bond were applied in two groups according to the manufacturers' recommendations. In the other two groups, the adhesives were applied after half-time of acid etching, 7 s for Single Bond and 10 s for Clearfil SE Primer. Resin crowns were built up and after 24 h storage in water at 37 °C, the teeth were sectioned to produce beams with cross-sectional area of approximately 0.49 mm^2. Specimens were tested in tension at 0.5 mm/min until failure. Fractured specimens were analyzed to determine the failure mode.

Results. Tensile bond strengths for Single Bond in primary dentin were higher than for Clearfil SE Bond. Shortening of acid etching time improved bond strength only for Single Bond, while no statistically significant difference was observed for Clearfil SE Bond when both etching times were compared.

Significance. No detrimental effect on bond strength was observed when the time of acid etching was shortened in 50%. Shortening the time for a procedure in a small child without compromising the quality of the work is a very important finding for the practicing pediatric dentist.

Introduction

Considering dentin adhesion, the same protocols have been indicated for primary and permanent teeth. However, in vitro studies have reported conflicting results concerning bond strength of

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distinct adhesive systems to primary dentin compared to permanent dentin. While lower values have been observed for primary dentin in some studies,[1–3] some have showed opposing results,[4] while others have described similar bond strengths for both substrates.[5–8]

Distinct characteristics of primary dentin may be responsible for the differences reported in the dental literature. There are substantial microstructural differences between permanent and primary dentin.[9] Greater tubule density and diameter have been reported for primary teeth[9] resulting in a reduced area of intertubular dentin available for bonding.[10] Chemically, the dentin of primary teeth seems to be more reactive to acidic conditioners,[11,12] what could be explained by the reduced degree of mineralization observed for primary hard dental tissues.[13,14] A scanning electron microscopy study has demonstrated that hybrid layers formed in primary dentin were nearly 25–30% thicker than that of permanent dentin using identical acid etching times.[11]

The increased thickness of hybrid layers in primary teeth may contribute to the lower bond strengths reported in the literature. In thick hybrid layers, incomplete penetration of resin monomers into the demineralized area might be more likely to occur, resulting in a zone of denuded collagen fibrils at the bottom of the hybrid layer.[15] These incomplete infiltrated zones are the result of a decreasing gradient of resin monomer diffusion within the acid-etched dentin.[16]

The non-impregnated demineralized dentin at the bottom of the hybrid layer has been described as the weakest zone within the adhesive interface.[17,18] Furthermore, incompletely infiltrated collagen fibrils in demineralized dentin are prone to undergo both hydrolytic and enzymatic degradation, including host-derived matrix metalloproteinases,[19] over time. Thus, the deeper demineralization observed for primary dentin using the same acid etching time than that of permanent tooth may facilitate the degradation of the resin–dentin bond, jeopardizing the longevity of the restoration.

A reduced acid etching time for primary dentin has been suggested as a way to maintain adequate bond strengths by the formation of a more homogeneous hybrid layer.[11,12] Due to the high reactivity of this substrate to etchants, they could be applied for shorter periods of time compared to permanent dentin.[20] Moreover, no positive correlation between the thickness of the hybrid layer and bond strength has been described in the literature.[15,18] Thus, the objective of this study was to determine if the reduced time of acid etching of primary dentin can influence the microtensile bond strength of adhesive systems to this substrate. The null hypothesis tested was that a shorter etching time does not influence the bond strength of either a conventional or a self-etching primer adhesive system to primary dentin.

Materials and methods

Tooth preparation

Twenty-four non-carious exfoliated human primary molars were selected for this study after the patient's informed consent was obtained under a protocol approved by the Araraquara Dental School Ethical Committee. The teeth were stored in 0.2% sodium azide at 4 °C and used within 3 months after exfoliation. In order to facilitate the manipulation of the teeth since they presented advanced physiological root resorption, the pulp chambers were filled with composite resin and artificial roots were reproduced using the same material.

Flat superficial dentin surfaces were created by grinding the occlusal enamel with wet 120 and 320-grit silicon carbide papers on a grinder (ECOMET 6, Buehler Ltd., Lake Bluff, IL). Each surface was further ground with 600-grit silicon carbide paper under running water for 60 s to produce a standardized smear layer.

Bonding procedures

The two commercially available adhesive systems used in this study (Table 1) were applied on the dentin etched for two different time periods: total time (as recommended by the manufacturers) or half of the total time. By combining the variables (etching time and adhesive system), sixteen teeth were randomly divided into 4 groups (4 teeth per group). The bonding procedures for each group are given in Table 2. The adhesives were applied according to the manufacturers' instructions, except for those groups where the dentin etching time was reduced by 50%. For Single Bond (3M ESPE, Dental Products, St Paul, MN), dentin was etched with 35% phosphoric acid for 15 or 7 s, followed by rinsing. A moist surface was assured by blot-drying the excess of water. Two layers of the adhesive were then applied, thinned with a gentle oil-free air stream and light cured for 10 s (Optilux 500, Demetron Research Co., Danbury, CT, EUA, 450 mW/cm^2). For Clearfil SE Bond (Kuraray Medical Inc., Tokyo, Japan), the primer was applied on a dry surface, left undisturbed for 20 or 10 s and thinned