Short- and long-term dentin bonding of experimental adhesives with a potential for chemical interaction at the dentin surface

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INTRODUCTION: There is growing evidence that the mechanism of certain dentin adhesives involves not only mechanical but also chemical bonding [1]. It was the aim of the present study to investigate the short- and long-term bonding to dentin of experimental adhesives. The adhesives contained bifunctional monomers with a potential capability to bond to the organic or the inorganic part of dentin surfaces.

METHODS: Extracted human teeth were used for the experiments. The teeth were given a flat dentin surface by grinding. The dentin surfaces were either demineralized with 25% phosphoric acid to give a surface rich in collagen, or deproteinized with 0.5% sodium hypochlorite to give a surface rich in hydroxy apatite [2]. Priming was carried out with a 35% aqueous mixture of HEMA. In the control group, the adhesive resin was a 40/60 mole/mole mixture of TEGDMA and UEDMA. In the experimental groups, three bifunctional monomers were investigated: MDP (10-methacryloyloxydecyl dihydrogenphosphate), 4-MET (4-methacryloyloxyethyl trimellitic acid mono ester) with a potential for bonding to hydroxy apatite, and 4-META (4-methacryloyl-oxyethyl trimellitate anhydride) with a potential for bonding to collagen. These monomers were mixed with TEGDMA and UEDMA in molar ratios of 15/34/51.

A cylindrical mold (h = 2.5 mm, d = 3.6 mm) was clamped to the treated dentin surface and resin composite (Filtek Supreme, 3M ESPE) was applied in the mold and light cured. The specimens were stored in water at 37ºC for 1 day or 1 year. The shear bond strength was then determined at a cross-head speed of 1 mm/min (n = 8).

RESULTS: The results are presented in Tables 1 and 2. Three-factorial ANOVA showed a significant influence of adhesive and storage time ($p <= 0.001$) but no interactions. There was no significant difference between the three bifunctional monomers with a potential for chemical interactions at the dentine surface ($p > 0.05$). The loss in bond strength due to long-term water storage was more pronounced in the demineralized group.

Table 1. Bonding (MPa) of experimental adhesives to H_3PO_4 - demineralized dentin. Means ± SD.

Adhesive	1 day	1 year
Control	17 ± 7	15 ± 9
MDP	28 ± 5	22 ± 7
4-MET	27 ± 5	18 ± 5
4-META	31 ± 6	20 ± 9

Table 2. Bonding (MPa) of experimental adhesives to NaOCl - deproteinized dentin. Means ± SD.

Adhesive	1 day	1 year
Control	18 ± 4	14 ± 3
MDP	24 ± 6	22 ± 8
4-MET	27 ± 5	27 ± 9
4-META	28 ± 5	25 ± 8

DISCUSSION & CONCLUSIONS: The potentially calcium-bonding adhesives (containing MDP and 4-MET) did not behave differently than the potentially collagen-bonding adhesive (containing 4-META). Thus, possible chemical interactions of the experimental adhesives were not reflected in the bond strengths. The bond strengths decreased as a consequence of long-term water storage. This is in agreement with earlier studies [3]. The presence of the hybrid layer in the demineralized group may have facilitated migration of water along the interface and thus increased the deterioration of the bond.

REFERENCES: [1] Y. Yoshida, B. van Meerbeek, Y. Nakayama, et al (2000) *J Dent Res* **79**:709-14. [2] T. Abo, E. Asmussen, S. Uno, et al (in press) *Acta Odontol Scand.* [3] J. de Munck, B. van Meerbeek, Y. Yoshida, et al (2003) J Dent Res **82**:136-140.

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