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Tensile bond strength of two adhesive systems in combination with flowable composites

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Introduction

Previous studies have shown a correlation between bond strength of dentin adhesive systems and different test modalities like shear or tensile bond tests (1). Other investigations focused on the influence of perfusion or specimen preparation (2,3). It is also known that the composite material and colour of this material have a significant influence on bond strength of dentin adhesive systems (4). But until now only low information is available about the correlation between the clinical performance of dentin adhesive systems combined with flowable composites on bond strength.

Objectives

The aim of the present investigation was to evaluate the influence of the tensile bond strength of two different composite/dentin adhesive combinations depending on the additional use of the corresponding flowable composite.

Material und Methods

Forty caries-free freshly extracted third molars, stored in saline for a maximum of seven days after extraction, were used in this study. All teeth were prepared in a special manner allowing the simulation of the dentin perfusion. Dentin specimens with a total thickness of 3.5 mm (± 0.5mm) were obtained under standardized conditions. All specimens were divided at random into four experimental groups of ten each. Group A: Tetric Ceram combined with Excite; groupB: like group A plus Tetric flow; group C: Admira used with Admira Bond; group D: group C plus Admira Flow. All materials were applied on a standardized surface area of 2 mm in diameter as recommended by the manufacturers (Fig. 1,2).

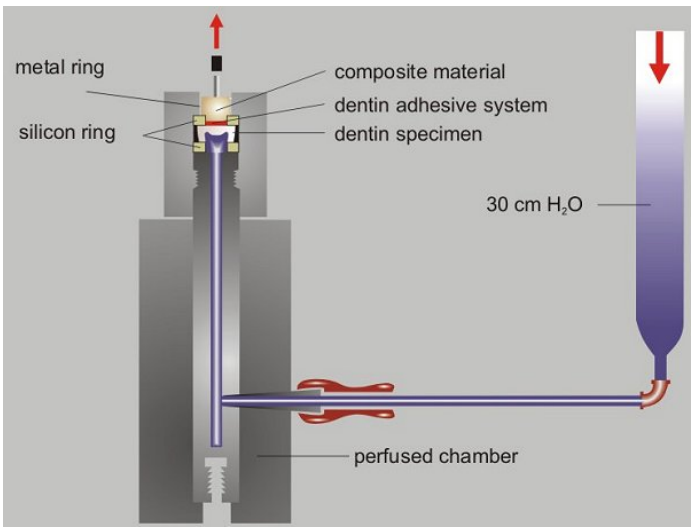


Fig. 1: Special designed apparatus to test tensile bond strength under permanent dentin perfusion.

Fig. 2: Special designed apparatus mounted in the universal testing machine.

Maximum tensile bond strength was evaluated using a universal testing machine. The experiments were performed 15 minutes after application and light curing of the composite material (Tetric Ceram, colour A2). For each group mean value and standard deviation were calculated. Statistical analysis were performed using ANOVA and Tukey's test. After these measurements all specimens were examined by scanning electron microscopy to evaluate different fracture modalities. Furthermore, unloaded specimens were examined. Therefore, dentin was removed using 50% nitric acid for 48 hours.

Results

In all groups tensile bond strength could be measured (Tab. 1).

	Group A	Group B	Group C	Group D
Mean value (in MPa)	4.74	10.02	3.59	7.36
Standard deviation	(± 1.81)	(± 4.72)	(± 1.37)	(± 3.91)

Tab. 1: Mean value and standard deviation within the different groups.

For the four test series following tensile bond strength values were evaluated (mean and standard deviation): In group A mean tensile bond strength of 4.74 MPa (± 1.81) was observed. The additional use of Tetric flow showed bond strength of 10.02 MPa (± 4.72). In the case of the ormocer Admira tensile bond strength was 3.59 MPa (± 1.37) and 7.36 MPa (± 3.91) when Admira flow was additionally applied (Tab. 1, Fig. 3).

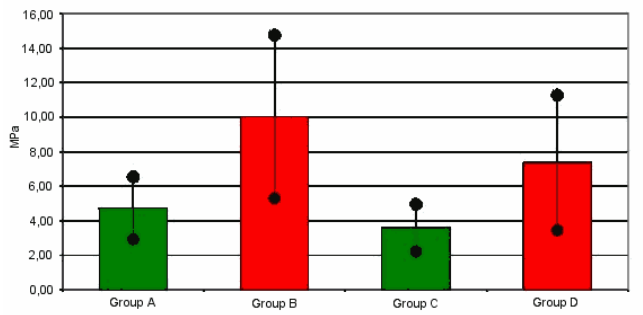


Fig. 3: Mean value and standard deviation within the different groups.

Statistical analysis showed a significant influence of the used dentin bonding agents on tensile bond strength in both modifications ($p = 0.01$, ANOVA). The values in group B were significantly higher than in group A and C. No significant differences could be detected between group C and D ($p < 0.05$, Tukey's test). The SEM evaluation of loaded specimens showed cohesive fractures within the composite resin in groups combined with the flowable material (B, D) (Fig. 5, 8).

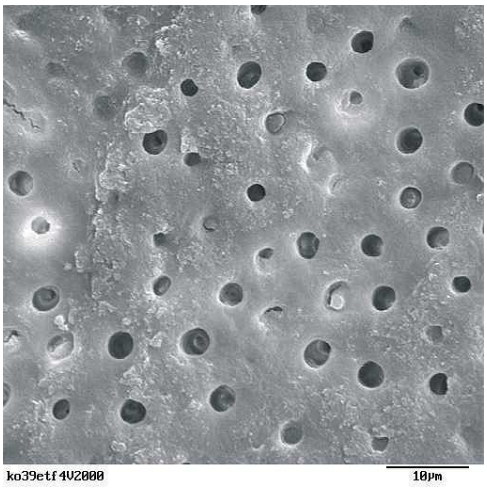


Fig. 5: Group B, Excite-Tetric Ceram combined with Tetric Flow. SEM; 2000x.

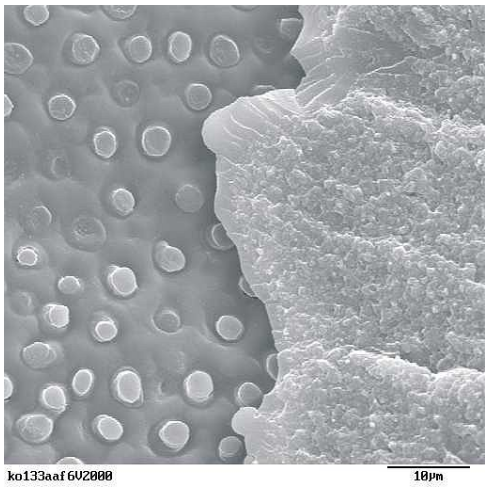
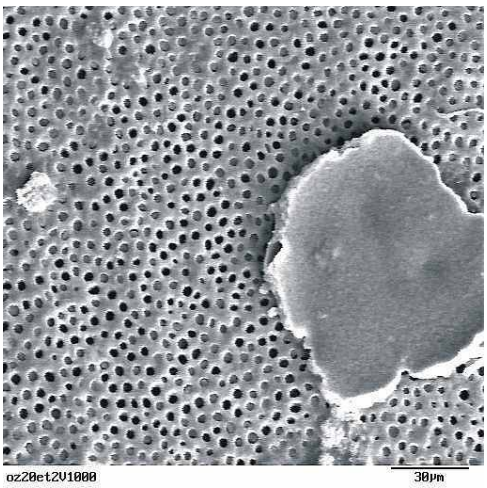


Fig. 8: Group D, Admira Bond-Admira combined with Admira Flow. SEM; 2000x.

In groups used without the flowable materials (A, C)in nearly all cases adhesive fractures could be observed. (Fig. 4, 7).



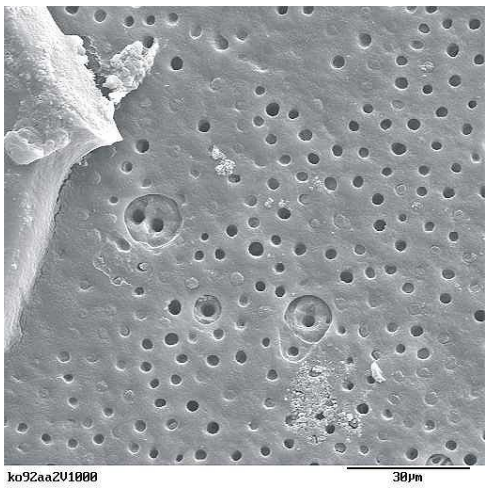


Fig. 4: Group A, Excite-Tetric Ceram. SEM; 1000x.

Fig. 8: Group D, Admira Bond-Admira combined with Admira Flow. SEM; 2000x.

The SEM evaluation of the unloaded specimen showed an increased tag formation in the case of the dentin adhesive system Excite (Fig. 6, 9).

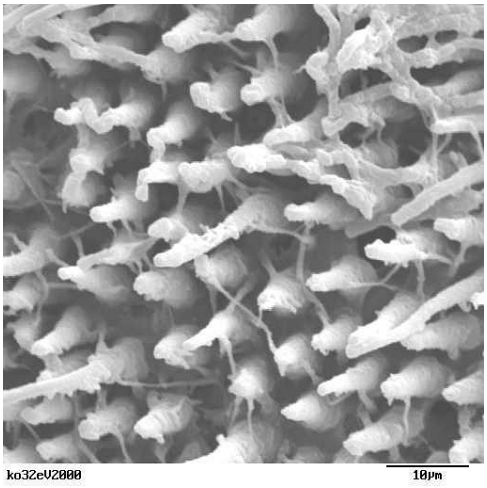


Fig. 6: Unloaded specimen treated with Excite. SEM; 2000x.

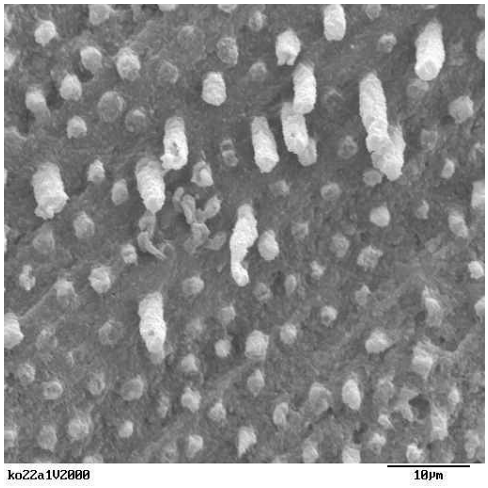


Fig. 9: Unloaded specimen treated with Admira Bond. SEM; 2000x.

Discussion and Conclusions

Within the limitations of an in vitro study, it can be concluded that the use of flowable composites might increase tensile bond strength for the used materials. The increasing bond strength in groups where flowable composites were additional used might help to improve the clinical performance of composites materials. Further investigations focusing on this point have to prove these findings.

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