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The influence of different stress modalities on tensile bond strength

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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 (4,5). But until now only low information is available on the influence of different simulated stress facors on bond strength.

Objectives

The aim of the present investigation was to evaluate the influence of four different stress modalities on tensile bond strength of a single-component dentin adhesive system.

Material und Methods

Sixty 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 specimen with a total thickness of 3.5 mm (± 0.5mm) were obtained under standardized conditions. All specimen were divided at random into four groups of fifteen each. In all groups the single-component dentin adhesive system Excite (Vivadent, Schaan, Liechtenstein) was applied as recommended by the manufacturer. Maximum tensile bond strength was evaluated after four different stress modalities (Fig. 3, 7) (group A: maximum load within one cycle; group B: maximum load after increasing cycles, step 2N; group C: maximum load after 100 constant cyles between 15 N and 30 N; group D: maximum load after 200 constant cycles between 15 N and 30 N) were simulated in a universal testing machine (Fig. 1, 2).

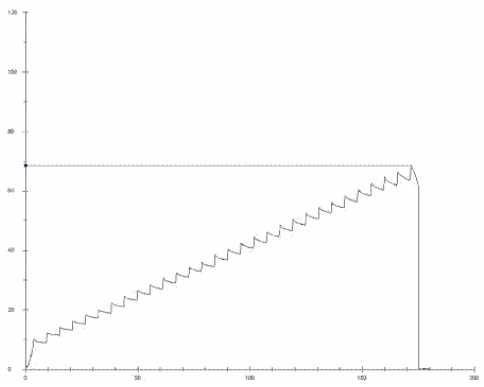

Fig. 3: Graphically expression of a specimen loaded with increasing forces.

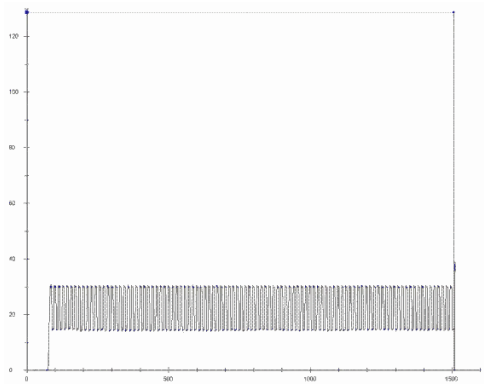

Fig. 7: Graphically expression of a specimen loaded with 100 constant cycles between 15 N and 30 N before maximum load.

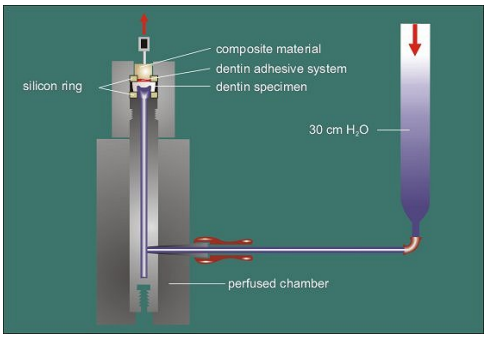

Fig. 1: Special designed apparatus to test tensile bond strength under permanent dentin perfusion.

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

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 was calculated. Statistical analysis were performed using ANOVA and Tukey's test. After these measurements all specimen were examined by scanning electron microscopy to evaluate different fracture modalities. Therfore dentin was removed using 50% nitric acid for 48 hours.

Results

In all groups tensile bond strength could be measured. The highest values were observed after 200 constant cycles between 15 N and 30 N before maximum load. (Tab. 1, Fig. 8).

	Group A	**Group B**	**Group C**	**Group D**
Mean values (in MPa)	5.25	4.01	5.80	8.23
Standard deviation	(± 0.87)	(± 1.10)	(± 2.11)	(± 1.24)

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

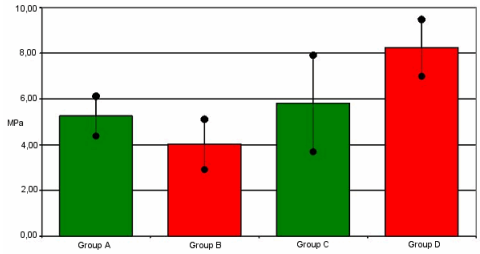

Fig. 8: Mean value and standard deviation within the different groups.

Statistical analysis showed a significant influence of the different stress modalities on tensile bond strength ($p < 0.001$, ANOVA). In group D tensile bond strength was significantly increased compared to all other groups ($p < 0.05$, Tukey's test). Furthermore, the statistical comparison between group B and C revealed a significant difference ($p < 0.05$, Tukey's test). The SEM evaluation of loaded specimen (group A) showed a cohesive fracture within the composite resin (Fig. 4). Specimen loaded with increasing force (group B) showed mixed fracture modes (Fig. 5), while the specimen in group C and D showed in nearly all cases only adhesive fractures (Fig. 6).

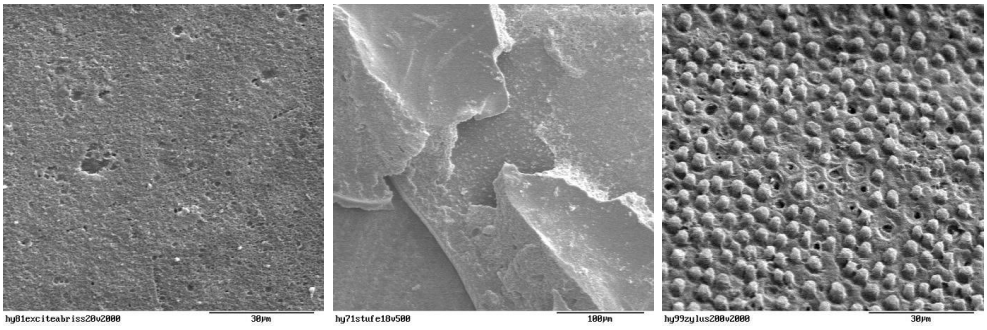

Fig. 4: Specimen loaded with maximum force in one cycle. SEM; 2000 x.

Fig. 5: Speciemen loaded with increasing forces. SEM, 500 x.

Fig. 6: Specimen loaded with 100 constant cycles before fracture. SEM; 2000 x.

Discussion and Conclusions

Within the limitations of an in vitro investigation, it can be concluded that different stress modalities might influence tensile bond strength of a single-component dentin adhesive system. The increasing bond strength after constant cyles might help to explain the known difference between in vitro tests and clinical performance.

Bibliography

1. May KN, Jr Swift EJ, Bayne SC (1997) Bond strengths of a new dentin adhesive system. Am J Dent 10: 195-198.
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3. Tagami J, Tao L, Pashley DH, Hosoda H, Sano H (1991) Effects of high-speed cutting on dentin permeability and bonding. Dent Mater 7: 240-246.
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This poster was submitted by Dr. Christian R. Gernhardt.

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The influence of different stress modalities on tensile bond strength.

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Introduction

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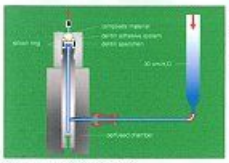

Fig. 1: Special designed apparatus to test tensile bond strength under permanent dentin perfusion

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

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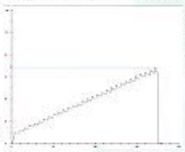

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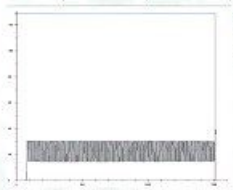

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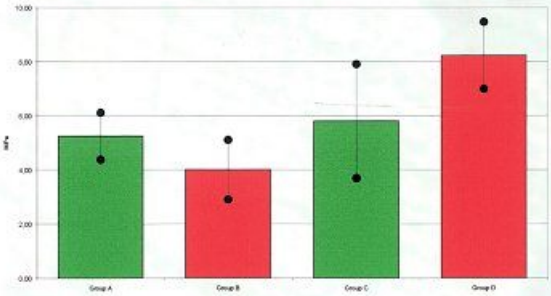

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