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Influence of Perfusion Solutions on Bond Strength of Self-conditioning Adhesives

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Introduction

Bonding to dentin and the complete sealing of the exposed dentinal surfaces remains problematic because of the highly hydrated and complex nature of the tissue.It is known from dental literature that there is a relationship between bond strength and a moist or perfused dentinal surface (1). Several in vitro studies have shown that adhesion of dentin adhesive systems is mostly reduced when used on moist, wet or physiological perfused dentin (2,3). For newer dentin adhesives that have a high hydrophilic capacity, the presence of moisture in the substrate might be desirable (4).

Objectives

The aim of this study was to evaluate the influence of two different perfusion solutions (saline, undiluted human plasma) on microtensile bond strength of four different self-conditioning dentin adhesives (Futurabond NR, Clearfil SE Bond, Xeno III, iBond) in vitro.

Material and Methods

120 freshly extracted molars, stored in saline for a maximum of fourteen days after extraction were included. All teeth were specially prepared allowing the simulation of dentin perfusion. Dentin specimens with a total thickness of 3.5 mm were obtained under standardized conditions. The distance between the pulp chamber and the occlusal plateau was adjusted to 2.0 mm (± 0.2 mm). The specimens were randomly assigned to eight experimental groups of fifteen samples each: group AS, AP: Futurabond NR; group BS, BP: Clearfil SE Bond; group CS,CP: XenoIII; group: DS, DP: iBond. In four groups (AS, BS, CS, DS) saline was used as perfusion solution, in four groups (AP, BP, CP, DP) undiluted human plasma was used. The adhesive systems were applied as recommended by the manufacturer. Maximum tensile bond strength was measured 15 minutes after application and light curing of the composite material (Clearfil APX) using an universal testing machine. For each group mean value and standard deviation were calculated. Statistical analysis was performed using ANOVA and Tukey's test.

Fig. 1: Used dentin adhesive system: Xeno III.

Fig. 2: Used dentin adhesive system: Futurabond NR.

Fig. 3: Used dentin adhesive system: Clearfil SE Bond.

Fig. 4: Used dentin adhesive system: iBond.

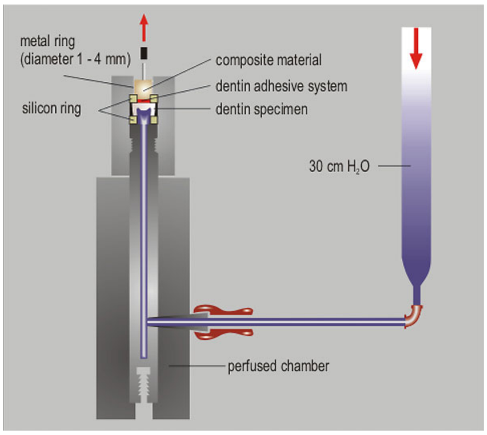
Fig. 5: Used composite material: Clearfil APX.

Results

For the eight test series following tensile bond strengths were evaluated (mean value and standard deviation in MPa): group AS: 31.57 (± 3.22), group AP: 45.38 (± 3.87), group BS: 28.81 (± 3.47), group BP: 39.44 (± 3.44), group CS: 23.80 (± 3.59); group CP: 30.30 (± 3.23), group DS: 28.62 (± 3.22), group DP: 46.34 (±3.24). Statistical analysis showed a significant influence of the used material and perfusion solution on microtensile bond strength ($p < 0.001$, ANOVA). Tensile bond strength in group AP and DP were significantly increased compared to all other groups ($p < 0.05$, Tukeys test). After using human plasma as dentin perfusion solution microtensile bond strength was significantly increased in all groups ($p < 0.05$, Tukeys test).

Fig. 6: Special designed apparatus mounted in a universal testing machine.

Fig. 7: Experimental device after loading until fracture.



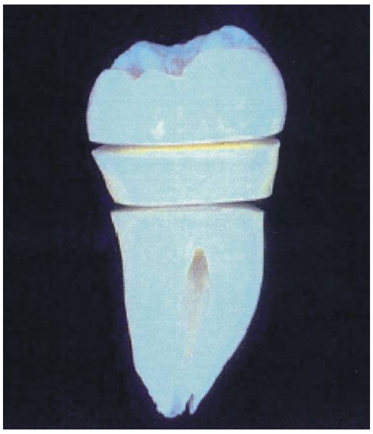


Fig. 8: Special designed apparatus to test tensile bond strength under permanent dentin perfusion.

Fig. 9: Cutting a dentinal slab. from a specimen.

Group	Group AS	Group AP	Group BS	Group BP	Group CS	Group CP	Group DS	Group DP
Mean value	31,57	45,38	28,81	39,44	23,80	30,30	28,62	46,34
Standard deviation	3,22	3,87	3,47	3,44	3,59	3,23	3,22	3,24

Tab. 1: Mean values and standard deviation within the different groups (in MPa)

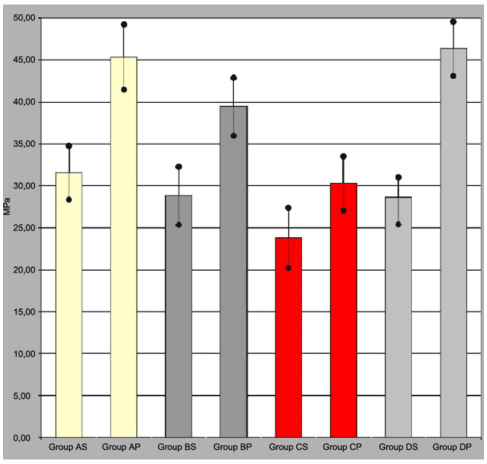


Fig.10: Mean values and standard deviation within the different groups (in MPa).

Conclusions

It can be concluded that the use of human plasma results in significantly higher values. Probably the use of human plasma might be a suitable alternative to imitate perfused dentin conditions in testing devices and might eliminate the recognizable discrepancy between different in vitro investigations focusing on bond strength of dentin adhesives.

Literature

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Abbreviations

MPa = megapascals
mm = millimeters

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Poster Faksimile: