Waterline Treatment Effect on Enamel and Dentin Bonding to Composite

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Abstract

Waterline treatments may be necessary to prevent bacterial growth in dental units. There has been concern that waterline treatments could inhibit bonding of restorations. **Objective:** Aim of this study was to determine whether BluTab waterline treatment changes the bond strength of OptiBond Solo Plus with Point 4 Composite to dentin and enamel. **Method:** Forty sectioned tooth samples were mounted in acrylic resin. Twenty were ground to expose enamel. Twenty were ground to expose dentin. All samples were finished with 1μm diamond polish and ultrasonic cleaned. Ten of the enamel samples were used with distilled water rinse (Enamel Control - EC) and the other ten were used with the BluTab waterline solution (EB). Dentin samples were treated in the same way with ten designated DC (control) and ten DB (Bluetab). Etching and bonding procedures were as the manufacture recommended; however, rinsing after etching was done with either distilled water or the BlueTab solution. Cylindrical silicone molds were placed over samples and composite was placed and cured. This allowed samples to have a consistent bonding area and geometry (3.2mm diameter, 5mm high). After storage in 100% humidity for 48hrs they were tested using a universal mechanical testing machine. Planar shear loading was applied at 1mm/min using a knife-edge anvil placed adjacent to the bonded composite. After converting to shear stress the data was subjected to ANOVA to determine if differences between treatments was statistically significant (α=0.05). **Results:** Enamel samples showed no statistical difference whether treated with distilled water or BluTab solution (p=0.18). No statistical differences were observed with dentin samples (p=0.43). Average values for the enamel samples were EC=16.7 and EB=19.5MPa. For the dentin samples the averages were DC=4.0 and DB=3.5MPa. **Conclusion:** There was no statistical difference between enamel or dentin samples prepared using distilled water or BluTab solution.

Introduction

Although a potential risk to the general patient population exists, there has been no major outbreak attributed to a Dental Unit Waterline (DUWL) that would suggest a quantifiable epidemiological risk. However, immuno-compromised patients elderly patients are at greater risk of infection. Dr. GC Blake first reported bacterial

contamination of dental Waterlines in 1963 in Great Britain. In mid 1990s the American dental association (ADA) organized a panel of experts to explore the waterline safety issues. The Organization for Safety and Asepsis Procedures (OSAP), the ADA and the CDC have been working hard ever since to share information and encourage more research in this area. The ADA addressed the problem in 1996 by issuing the ADA statement on Dental Unit Waterline, which called for a maximum of 200 colony-forming bacteria per milliliter of water in unfiltered DUWL output by the year 2000. At present the CDC and the ADA are focusing on meeting the EPA and American Water Works Association safe drinking water standard of less than 500 CFU/ml. Currently there are several ways to improve and maintain the quality of the water in dental units: 1) waterline flushing and purging before each patient, 2) independent reservoirs, 3) filtration systems, 4) intermittent chemical treatment to disinfect the system, 5) continuous chemical treatment, and 6) sterile water delivery system.

While continuous chemical control of bacterial contamination is effective, concerns have been expressed regarding the possible adverse effects on dentin and enamel bonding. Some previous studies have shown that some waterline treatments do not affect bond strength, whereas, while other waterline treatments led to diminished bond strength (Roberts et. al., 2000; Knight et. al., 2001; von Fraunhofer et. al., 2004). Reports in the literature indicate that some treatments, specially the ones containing essential oils (Listerine), can have adverse effect on dentin bonding.

This in-vitro study was necessary to determine if a recently developed waterline treatment (BluTab, ConFirm Monitoring Systems) has an adverse effect on composite bonding.

Materials and Methods

Forty extracted teeth were selected, cleaned, and cut into two approximately equal sized halves (using a low speed water cooled diamond saw). All teeth halves were mounted in acrylic mounting resin. Forty of the mounted teeth halves were ground to produce a flat in the exposed surfaces in order to expose enamel: (E) group. The other forty mounted teeth halves were ground further to expose dentin: (D) group. All ground surfaces were then polished with one-micron diamond polish and then ultrasonic cleaned in distilled water.

Both the enamel group (E) and the dentin group (D) were each randomly divided into four treatment groups depending on the medium and the composite bonding system. The two mediums were: 1) distilled water and 2) BluTab waterline treatment (ConFirm Monitoring Systems). The BluTab was prepared by dissolving one tablet in 700 ml of distilled water. The two bonding systems were A) Optibond Solo Plus with Point 4 composite (Kerr) and B) Single Bond Plus with Z100 (3M ESPE). This led to eight treatment groups: for the enamel group (E1A), (E1B), (E2A), and (E2B) and for the dentin group (D1A), (D1B), (D2A), and (D2B).

The surfaces were prepared in compliance with each bonding system's directions except the experimental waterline treatment was used, instead of water, for groups (2A) and (2B). A silicone mold made of was placed over the surfaces to contain the composite and form a 3 mm diameter by 5 mm long cylinder attached to the tooth surface. The composite was placed and cured in 2 mm increments following the manufacturer's directions.

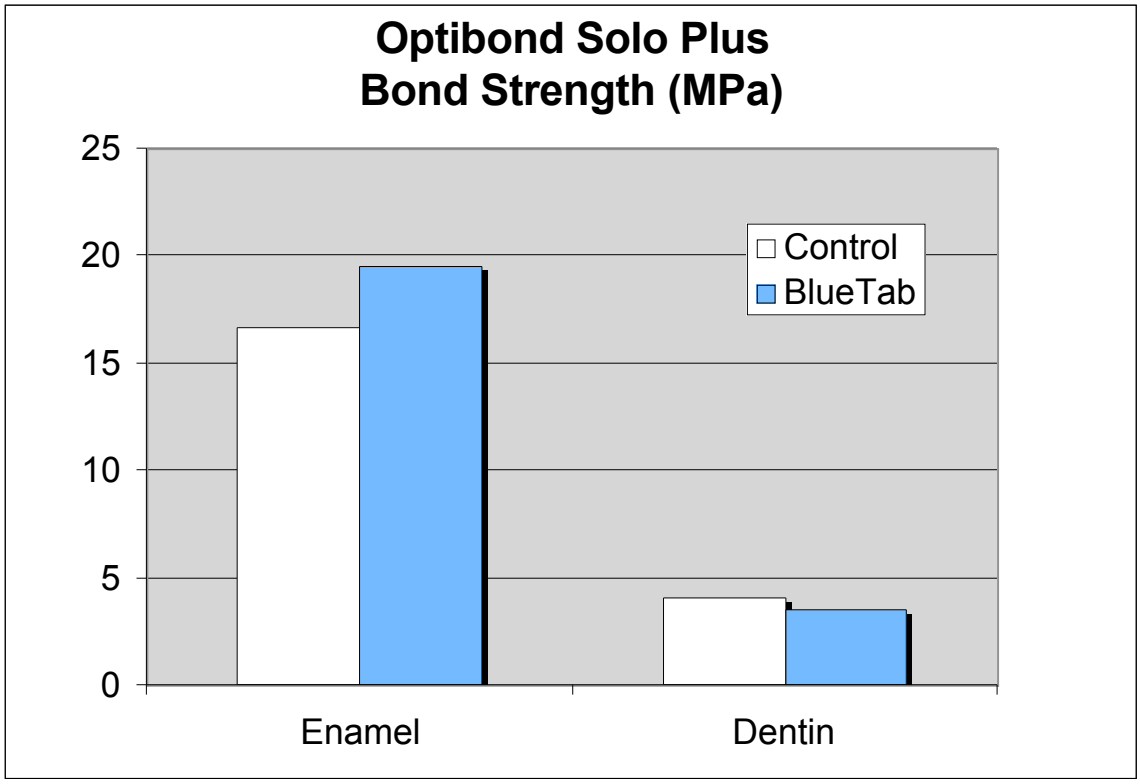
The samples were then bond strength tested in the shear mode using a knife-edge loading anvil and an Instron Universal Testing Machine. The shear rate was 1 mm/minute. ANOVA tests were used to determine if differences were statistically significant with α=0.05.

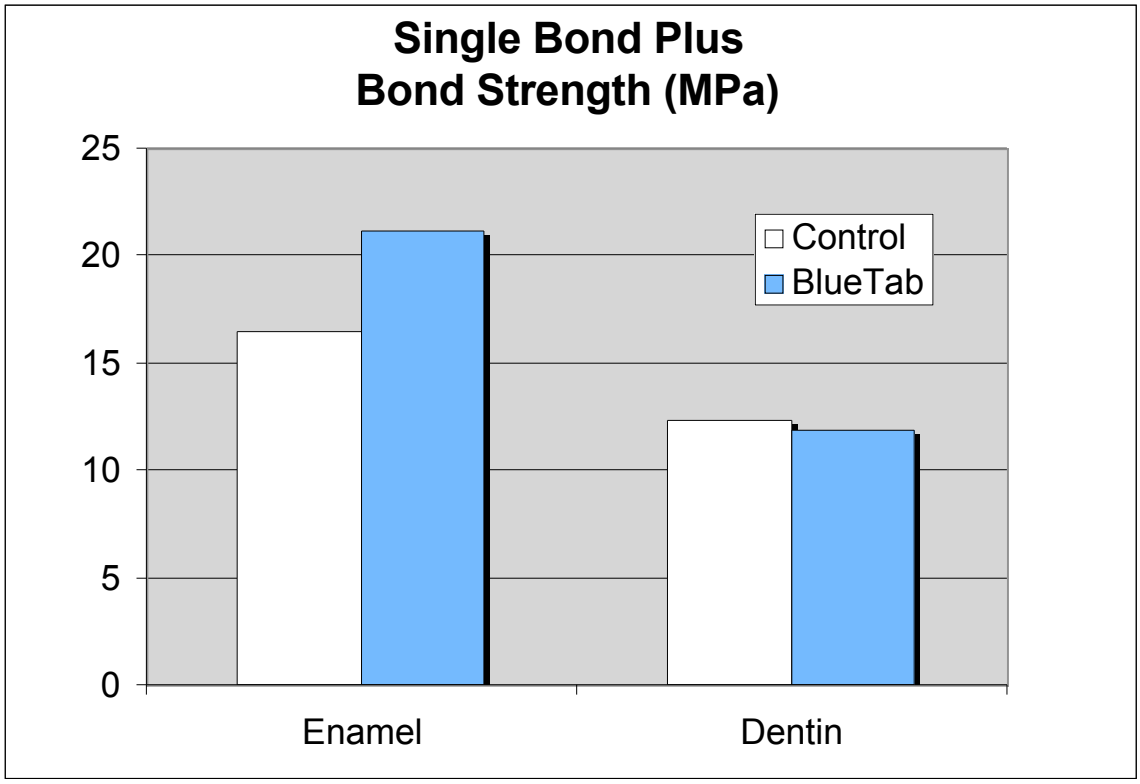
Results and Discussion

The BluTab waterline treatment did not cause statistically significant changes in bond strength as compared to the controls in either the Optibond Solo Plus or the Single Bond Plus samples. In addition, neither the enamel nor the dentin samples showed statistical difference in bond strengths between the distilled water and the BluTab treatments.

While bond strength was not affected by the use of the waterline treatment in either material, significant differences in bond strength between the two materials were found in the dentin samples. The Optibond Solo Plus samples showed lower bond strengths than the Single Bond Plus samples with dentin bonding. The Optibond Solo Plus samples showed significantly lower bond strengths in dentin than the enamel.

The differences between the control and the waterline treatment group were not statically significant. However, small non-significant increases in bond strength were found with the enamel bonded samples that had been treated with BluTab.


Optibond Solo Plus
Bond Strength (MPa)
25
20
15
10
5
0
Control
BlueTab
Enamel
Dentin



Descriptive Statistics

Optibond Solo Plus	Mean	Standard Deviation
Enamel/Control	16.7	4.1
Enamel/BluTab	19.5	5.0
Dentin/Control	4.0	.9
Dentin/BluTab	3.5	1.7

Single Bond Plus	Mean	Standard Deviation
Enamel/Control	16.5	8.5
Enamel/BluTab	21.2	10.0
Dentin/Control	12.3	5.3
Dentin/BluTab	11.8	5.1

ANOVA Table

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
Material	1	471.354	471.354	15.302	.0002
Specimen (Dentin or Enamel)	1	2537.887	2537.887	82.388	.0001
Treatment	1	61.620	61.620	2.000	.1606
Material * Specimen	1	328.718	328.718	10.671	.0015
Material * Specimen * Treatment	2	8.694	4.347	.141	.8686
Specimen * Treatment	1	102.955	102.955	3.342	.0708
Residual	92	2833.967	30.804		

Dependent: Bond Strength (MPa)

ANOVA Statistics

Optibond Solo Plus	
Enamel: Control vs. BluTab	p=0.18
Dentin: Control vs. BluTab	p=0.43

Single Bond Plus	
Enamel Control vs. BluTab	p=0.28
Dentin/Control vs. BluTab	p=0.76

(p values less than 0.05 indicate statistically significant differences)

Conclusion

The final results indicate that there was no significant difference between the BluTab solution rinsed samples and the distilled water rinsed samples. This was true for both bonding systems and with both enamel and dentin.

References

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Acknowledgements

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