The Bond Ability of Silane Coupling Agent-containing Self-etching Adhesive to Composite resin

○Ker-Kong Chen[1], Tomohiro Hoshika[2], Chun-Chan Ting[3], Yoshihiro Nishitani[4], Masahiro Yoshiyama[4]

1. Department of Conservative Dentistry, Kaohsiung Medical University Chung-Ho Memorial Hospital and Kaohsiung Medical University, Kaohsiung, Taiwan
2. Department of Operative Dentistry, Okayama University Hospital, Japan
3. School of Dentistry, Kaohsiung Medical University, Kaohsiung, Taiwan
4. Department of Operative Dentistry, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Japan

I. Objective

This study was to find out whether the silane coupling agent-containing self-etch adhesive has an ability to bond composite resin well as the separate application of adhesive and silane coupling agent or not.

II. Materials & Methods

Composite resin block was fabricated incrementally by Beautifil II (BF, AO2 shade, Shofu) in a mold (diameter: 15mm, depth: 6mm) with 40 seconds light curing for each 2mm depth. Composite resin block was ground by #600 sandpaper to remove 0.3mm thickness and ultrasonically cleaned for 5 minutes. The prepared surface was applied with the silane coupling agent-containing adhesive (SBU, SingleBond Universal, 3M) or adhesive (BBM, BeautiBond Multi, Shofu) + silane coupling agent (BBP, BeautiBond Multi PR Plus, Shofu) according to the instructions of manufacturer and then refilled with Beautifil II (BF, A2 shade) the same way as the former resin block. The resin block was immersed in 37℃ water for 24 hours and then trimmed into 1×1 mm non-trimming specimens. Half of the specimens were supplied for microtensile bond strength test immediately, while the rest were thermocycled for 5,000 times in 5℃ and 55℃ for 1 minute, separatively, and then also performed the microtensile bond strength.

III. Results

Regardless of the application type of silane coupling agent or thermocycling, the tensile bond strength presented no significant difference between each other (Fig. 1). Each adhesive exhibited a lower bond strength with significant difference between thermocycling and non-thermocycling groups. The silane coupling agent-containing self-etch adhesive (SBU) showed similar bond strength as the separate application type adhesive (BMM+BBP) between thermocycling and non-thermocycling conditions compared with. Both of the adhesives showed that more than half of the specimens were cohesive failure instead of the interfacial failure.

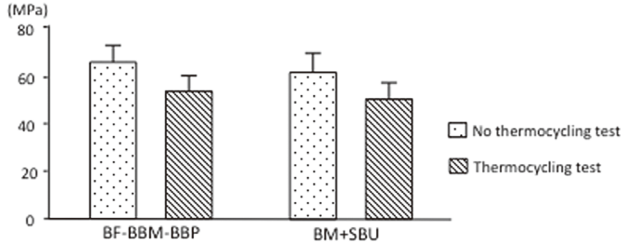

Fig. 1 Microtensile bond strength of each adhesive with/without thermocycling test

IV. Conclusion

Silane coupling agent-containing adhesive (SingleBond Universal) possesses a satisfactory bonding ability to composite resin comparable to the combined application of silane coupling agent and adhesive (BeautiBond Multi and BeautiBond Multi PR Plus).

Effects of Collagen Cross-linkers on Dentin Bond Strengths and Durability

○Yung-Show Chiang[1], Shu-Fen Chuang[2]

[1] Department of dentistry, Tainan municipal hospital; [2] Institute of Oral Medicine, National Cheng Kung University

I. Objective

The purpose of this study was to investigate the collagen cross-linking effects of either riboflavin (RF) combined with ultraviolet A (UVA) or glutaraldehyde and their applications in improving dentin bond strengths and durability.

II. Materials & Methods

Twenty sound extracted human molars were embedded in epoxy resin and ground to expose dentin. These teeth were prepared for different collagen cross-linking treatments. The experimental groups were: DW, distill water treatment; RF0.1/U1, 0.1% RF then 1-minute UVA irradiation, RF0.1/U2, 0.1% RF then 2-minute UVA irradiation; RF1/U1, 1% RF and 1-minute UVA irradiation, and GD, 5% glutaraldehyde (GD) treatment for 1 minute. The treated dentin surfaces received adhesive treatment (Scotchbond Multipurpose) and resin composite (Filtek Z250) restorations. After storage for 24 hours in 37°C distilled water, a half of restored teeth were sectioned perpendicular to the bonded interface into 0.9mm x 0.9mm microbeams. Half of the microbeams received the microtensile bond strength (μTBS) test after 24 hours (early), and the other half received the test after 7-day enzymatic digestion (Enz).

III. Results

The μTBS values of experimental groups are listed in Table 1. For the early μTBS, significant differences existed among groups ($p < 0.05$). R0.1U2, R1U1 and GD significantly increased the μTBS. The highest early bond strength obtained with R0.1U2 treatment. RF/UVA maintained the resin-dentin bond strength even after 7-day enzymatic digestion. However, the bond strength of GD group reduced after 7-day Enz.

Table 1. The mean (standard error) values (MPa) of μTBS in experimental groups.

Group	Early	Enz
DW	29.18 (5.94) ^{Ba}	26.30 (8.01) ^{Ba}
R0.1U1	40.40 (5.89) ^{ABa}	27.88 (5.09) ^{Ba}
R0.1U2	54.41 (3.68) ^{Aa}	51.70 (4.21) ^{Aa}
R1U1	49.51 (4.31) ^{Aa}	42.70 (5.13) ^{ABa}
GD	47.84 (5.29) ^{Aa}	31.48 (4.65) ^{ABb}

The uppercase letter represents the significant differences among surface treatments.
The lowercase letter represents the significant differences between degradation tests.

IV. Conclusion

The collagen cross-linking with RF/UVA or GD increases the early dentin bond strength. The RF/UVA treatment also enhances the resistance of dentin adhesion to enzymatic digestion.

Using NIR Activated Phosphors to Enhance Polymerization of Dental Composites

○Chu-Chun Liao[1], Shu-Fen Chuang[1]*, Jui-Che Lin[2]

1. Institute of Oral Medicine,
2. Department of Chemical Engineering,
National Cheng Kung University, Tainan, Taiwan

Abstract

I. **Objective:**

To develop a novel curing protocol of dental composites with near-infrared (NIR)-activated upconversion phosphors (UP), and to examine its efficacy in enhancing degree of polymerization.

II. Materials & Methods:

The $NaYF_4$ phosphors were chosen as additional fillers in dental composites. A NIR diodes laser was used to excite this UP and emit a blue light of 475 nm. The absorbance and excitation spectra of this UP were examined at different NIR intensities. The UP was mixed into Z100 microhybrid composites at different ratios to generate three composites: a microhybrid composite Z100 (3M/ESPE), UP5 (the mixture of 5 wt% UP and Z100), and UP10 (the mixture of 10 wt% UP and Z100). These test composites were filled into a slot and covered with a metal lid to be irradiated through a side window. For each composite, the specimens were separately irradiated by two regimens: blue light for 20 s (BL) and with an adjunct NIR irradiation for 10 min (BL+NIR). Microhardness at different depths of composites was measure to compare the degree of conversion among different groups. The curing depths of different composite materials were also evaluated. A temperature analysis was performed to measure the temperature rise during NIR irradiation.

III. Results:

For the test $NaYF_4$ phosphors, a linear relationship between the intensities of excitation NIR and emission BL was confirmed. For BL curing regimen, three composites did not show significantly different microhardness values. For BL+NIR regimen, UP5 showed significantly higher microhardness at the irradiated surface and the top 3-mm curing depths, compared to those of Z100 and UP10. The microhardness values in UP10 composites did not differ from those of Z100 either under BL or BL+NIR. The adjunct NIR increased the curing depths of three composite for 0.2-0.5 mm compared to BL alone. The temperature analysis showed NIR irradiation on UP5 for 10 min resulted into temperature rise about 6°C under the composite of 4 mm thickness.

IV. Conclusion

The use of UP and NIR irradiation increases the microhardness and the curing depths of dental composites. According to these findings, this new protocol could be an adjunct mode to enhance the polymerization of resin composites. However, the long NIR-irradiation duration and temperature rise may impede its clinical use.