

INTRODUCTION

Most self-cure resin cements employ BPO/amine redox initiator system and suffer so-called “incompatibility” with simplified yet more acidic single-component self-etch adhesive systems. As a result, rather low dentin bond strength is obtained when a resin cement is used in combination with one of those more acidic adhesives in dark-cure mode.

This “incompatibility” between one-bottle adhesives and self-cured resin cements could be attributed to the inability of a BPO/Amine redox initiator system used in current resin cements to initiate polymerization in the presence of quite acidic monomers within the air-inhibited layer of the light-cured adhesive as a result of an acid-base reaction. The degradation of redox initiator system of the cement at the cement/adhesive interface could significantly compromise the bond between a self-cure resin cement and a self-etch primer/adhesive. To minimize the incompatibility problem, some manufacturers provided a separate activator that needs to be mixed with the one-bottle adhesive for enhanced dark-cure efficiency. Although effective, the activator introduces complexity into the bonding process in that there is an additional component and an extra mixing step involved.

Recently, a new dual-cure resin cement, NX3 (Kerr), was introduced to address above mentioned “incompatibility” issue and in the meanwhile provide superb color stability and esthetics. NX3 employs a unique redox initiator system that is acid resistant and can initiate polymerization in the dark and in the presence of a quite acidic environment.

OBJECTIVE

To test the dentin shear bond strength (SBS) of several 7th generation adhesives using the following three resin cements (NX3 (Kerr), Calibra (Dentsply), and Variolink (Vivadent)) in self-cure mode to determine if NX3 provides improved bond compatibility.

MATERIALS

- NX3 (Cement), OptiBond All-In-One (Adhesive)
- Calibra (Cement), Xeno IV (Adhesive)
- Clearfil S3 Bond (Adhesive)
- G-Bond (Adhesive)
- iBond (Adhesive)
- Variolink (Cement)

- Kerr
- Dentsply
- Kuraray
- GC America
- Kulzer
- Vivadent

METHOD

Extracted human teeth were embedded in cold-cure acrylics. A set of six specimens were prepared for each material. A low speed diamond saw was used to remove the crown and expose the occlusal dentin. The dentin substrates were polished with 240-grit and then 600-grit SiC paper, rinsed thoroughly with water, and air dried for a few second. Each adhesive was used without an activator for the purpose of truly assessing the degree of incompatibility. Each adhesive was light-cured, and each cement was self-cured.

The adhesive covered substrate was then held securely by a bonding jig (Ultradent Inc.) with a cylindrical mold ($\Phi = 2.38$ mm). The prepared specimens (n=6 for each cement) were stored in de-ionized water at 37°C for 24 hours before being subjected to debonding under shear force.

The specimens in each set were tested on an Instron mechanical tester (Model 4467, Instron Corporation) in shear mode using a notched (semi-circular) edge at a crosshead speed of 1.0 mm/min. Shear bond strength values in MPa were calculated by dividing the peak load by the bonding area.

Statistical analysis was performed using One-way ANOVA and Bonferroni’s method for pair-wise comparison to determine significant differences among groups (p<0.05).



Figure 1: Bonding Jig



Figure 2: Shear Bond Test Set-Up

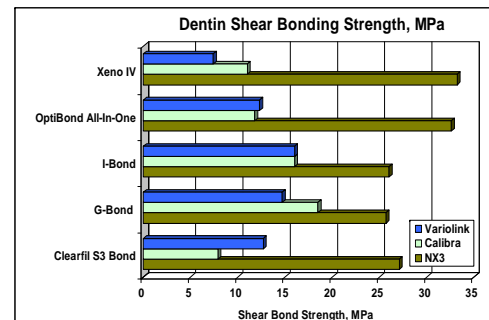
DISCUSSION

When used in conjunction with all five commercial adhesives, NX3 provided the highest dentin shear bond strengths among the three resin cements when the cements were self-cured. ANOVA analysis revealed that the bond strength obtained with NX3 was significantly (p < 0.05) higher than that obtained with Calibra and Variolink for each adhesive system. ANOVA analysis also showed that bond strengths obtained with Calibra and Variolink were not statistically (p > 0.05) different from each other for each adhesive with the exception of G-Bond. The results of this study clearly indicate that NX3 provided enhanced bond compatibility with various commercial adhesives as demonstrated by its excellent bond strengths. This enhanced compatibility could be attributed to NX3’s unique redox initiator system that is quite resistant to acidic monomers within the air-inhibited layer of the light-cured adhesive. NX3 achieves its excellent bond compatibility with 7th generation adhesives without the need for an activator for the adhesive, thereby simplifying the cementation procedure.

RESULTS

		Dentin Shear Bond Strength, MPa		
		Cement (Self-cured)		
		NX3	Calibra	Variolink
Adhesive	Clearfil S3 Bond	27.1 ± 1.6 ^a	7.9 ± 6.4 ^b	12.7 ± 6.5 ^b
	G-Bond	25.7 ± 1.2 ^a	18.5 ± 3.3 ^b	14.7 ± 3.3 ^c
	iBond	26.0 ± 0.6 ^a	16.0 ± 4.7 ^b	16.0 ± 6.6 ^b
	Optibond All-In-One	32.6 ± 5.5 ^a	11.8 ± 1.7 ^b	12.3 ± 1.4 ^b
	Xeno IV	33.2 ± 9.3 ^a	11.0 ± 3.3 ^b	7.4 ± 1.5 ^b

* Means with different letters within the same row are statistically different at p<0.05



CONCLUSION

For all five 7th generation adhesives, NX3 exhibited the highest SBS or best bond compatibility among the three cements tested. NX3 achieves its excellent bond compatibility with 7th generation adhesives without the need for an activator for the adhesive, thereby simplifying the cementation procedure.