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Original article

The effect of curing conditions on the dentin bond strength of two dual-cure resin cements

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ABSTRACT

Purpose: The purpose of this study was to determine the effect of the curing condition (i.e., the curing mode and restoration thickness) on the tensile bond strength of a dual-cure resin cement applied to dentin.
Methods: Indirect composite resin disks (1, 2, and 3 mm in thickness) were prepared. The irradiance of a halogen light curing unit through each disk was measured by a curing radiometer. A measurement was also taken for the condition with no disk. Following this, two dual-cure resin cements, Panavia F2.0 and Panavia V5, were polymerized in either dual-cure mode or self-cure mode to bond the composite resin disk to the flat dentin surface. The specimens were sectioned and subjected to a microtensile bond strength (μTBS) test after 24 h of water storage. The data were statistically analyzed by two-way ANOVA followed with multiple comparisons by post-hoc Tukey's test ($\alpha = 0.05$).
Results: The irradiance values [mW/cm^2] measured through indirect composite resin disks were 600 (0 mm), 200 (1 mm), 90 (2 mm), and not detected (3 mm). Two-way ANOVA indicated that both the curing condition and the type of resin cement affected the μTBS ($p < 0.001$). The μTBS results for Panavia V5 bonded to dentin were significantly higher than those of Panavia F2.0 bonded to dentin ($p < 0.05$).
Conclusions: The curing condition affected the tensile bond strength of the dual-cure resin cements to dentin. A newly developed resin cement, Panavia V5, showed higher dentin bonding than Panavia F2.0 in both dual- and self-cure modes.

1. Introduction

Indirect esthetic restorations and subsequent cementation with resin cements have become increasingly popular. Resin cements are the most favorable luting agents for indirect esthetic restorations due to their high retentive strength [1,2], resistance to wear [3,4], and low solubility [5–7]. To ensure optimal polymerization of resin cement in deep areas, the dual-cure system, which contains both a photo-initiator and a self-cure initiator, has been widely adopted.

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Table 1 – Materials used in this study.

Material	Batch no.	Compositions	Procedure
Resin cement			
Panavia F 2.0 (Brown shade)	1P0021	ED Primer II (Liquid A+B): pH 2.4	Apply liquid A+B, leave for 30s, gently air-dry, place hand-mixed pastes, light cure for 20s
		Liquid A: 10-MDP, 5-NMSA, HEMA, accelerators, water Liquid B: 5-NMSA, accelerators, catalysts, water	
	1N0048	Paste-A: 10-MDP, hydrophobic aromatic dimethacrylate, hydrophobic aliphatic dimethacrylate, hydrophilic aliphatic dimethacrylate, silanated silica filler, silanated colloidal silica, dl-camphorquinone, catalysts, initiators Paste-B: Hydrophobic aromatic dimethacrylate, hydrophobic aliphatic dimethacrylate, hydrophilic aliphatic dimethacrylate, silanated barium glass filler, surface treated sodium fluoride, catalysts, accelerators, pigments	
Panavia V5 (Universal shade)	130926-U	Tooth primer: pH 2.0	Apply and leave primer for 20s, gently air-dry, place paste from auto-mix syringe, light cure for 20s
		10-MDP, original multifunctional monomer, new polymerization accelerator, HEMA, water, stabilizer Cement: Bis-GMA, TEGDEMA, aromatic multifunctional monomer, aliphatic multifunctional monomer, new chemical polymerization accelerator, dl-camphor quinone, photopolymerization accelerator, surface treated barium glass, fluoroalumino-silicate glass, fine particulate filler	

Manufacturer: Kuraray Noritake Dental, Tokyo, Japan.
10-MDP: 10-methacryloyloxydecyl dihydrogen phosphate; 5-NMSA: N-methacrylic-5-aminosalicrylic acid; HEMA: hydroxyethyl methacrylate; Bis-GMA: bisphenol-A-diglycidylmethacrylate; TEGDMA: triethylene glycol dimethacrylate.

The performance of dual-cure resin cement has been reported to be impaired under insufficient light [8–10]. Light attenuation occurs in clinical situations due to two factors: first, the distance between the tip of the light source and thecementing system, and second, the opacity and thickness of the indirect restorative materials. The self-cure polymerization component of the cementing system (e.g., benzoyl peroxide (BPO)/tertiary amine pair) is expected to ensure complete polymerization by a self-cure reaction following exposure to light. However, several studies reported that most dual-cure resin cements are extremely dependent on photoactivation, and self-cure polymerization alone does not ensure the complete polymerization of the resin cement [11–13]. In an attempt to overcome these problems, a new self-cure polymerization catalyst was developed and added to the primer system of a resin cement named Panavia V5.

The purposes of this study were as follows: (i) to determine the effect of the curing mode on the dentin bond strength of two dual-cure resin cements, and (ii) to determine the effect of the indirect composite resin disk thickness on the dentin bond strength of two dual-cure resin cements. The null hypotheses proposed were as follows: (i) the curing mode did not affect the bond strength of resin cements to dentin, and (ii) the indirect composite resin disk thickness did not affect the bond strength of resin cements to dentin.

2. Materials and methods

2.1. *Dual-cure resin cements used in this study*

The cements used in this study are listed in Table 1 and consisted of Panavia F2.0 (Brown shade) with ED Primer II (Kuraray Noritake Dental, Tokyo, Japan) and Panavia V5 (Universal shade) with Tooth Primer (Kuraray Noritake Dental). Both of these products are dual-cure resin cements with one-step self-etching primers.

2.2. *Preparation of indirect composite resin disks*

Indirect composite resin disks (1, 2, and 3mm in thickness, 10mm in diameter) were fabricated from a composite resin (Estenia C&B Shade DA2; Kuraray Noritake Dental) using a silicone mold. Glass microscope slides were placed over the top and the bottom of the uncured composite resin. Both sides of the disks were cured for 60s each, for a total of 120s using a halogen light curing unit (Optilux 501; Demetron Kerr,