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ORIGINAL ARTICLE

Effects of different light sources on microleakage of composite resins with different monomer structures†

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light curing units;
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Abstract *Background/purpose:* The aim of this study was to investigate the effects of different light curing units (LCUs) on the microleakage of different composite resins.
Materials and methods: Forty-five freshly extracted human third molars were selected for this study. Standardized class V cavities were prepared on the buccal and lingual surfaces of each tooth. The teeth were randomly divided into three composite resin groups, comprising two dimethacrylate-based hybrid composites and a silorane-based composite. Each composite resin group was randomly divided into three subgroups for curing with three different LCUs ($n = 5$). Of the three different LCUs used, one was quartz–tungsten–halogen and two were light-emitting diodes (LEDs) with different power outputs. The teeth were immersed in a 2% methylene blue dye solution and examined under a stereomicroscope. Results were statistically analyzed using Kruskal–Wallis and Dunn tests.
Results: When all composite resin groups were compared, the lowest marginal leakage scores were obtained with the Filtek Silorane composite group, and they statistically significantly differed from those of the other groups ($P < 0.05$). Among all groups, the lowest marginal leakage value was obtained for the LED 1055 subgroup of the Filtek Silorane composite group, and the highest marginal leakage value was obtained for the quartz–tungsten–halogen subgroup of the Aelite Aesthetic Enamel composite group.
Conclusion: It was concluded that it is not possible to entirely prevent microleakage, but it can be minimized with silorane-based composite resins and high-density-output LED LCUs.

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Introduction

Two major properties of dental composites that still need improvement are their polymerization shrinkage and the related polymerization stress. Both parameters contribute to different clinical challenges such as reduced marginal integrity and postoperative sensitivity.[1] To overcome these shrinkage-induced problems, extensive efforts have been made over several years to develop low-shrinkage dental restorative materials.[2] The most recent one is based on using ring-opening polymerization of silorane molecules, instead of free radical polymerization of dimethacrylate monomers. The term "silorane" was introduced to represent hybrid monomer systems that contain both siloxane and oxirane structural moieties. Concerning the material properties of siloranes, the cyclosiloxane backbone imparts hydrophobicity, whereas the cycloaliphatic oxirane sites have high reactivity and shrink less during polymerization than methacrylates. Some cyclosiloxanes were reported to undergo cationic ring-opening polymerization with volume expansion.[3] This novel resin is considered to have combined the two key advantages of individual components: low shrinkage due to the ring-opening oxirane monomer and increased hydrophobicity due to the presence of siloxane species.[1]

Until recently, light emitted from a halogen light bulb was used to cure composites. These types of curing units usually operate at light intensities of 400–800 mW/cm^2 and cure composite filling material within 40 seconds.[4]

Solid-state light-emitting diode (LED) technology was proposed in 1995 for the polymerization of light-cured dental materials to overcome the shortcomings of halogen visible light curing units (LCUs).[5] LEDs use junctions of doped semiconductors to generate light instead of the hot filaments used in halogen bulbs.[6] LEDs have a lifetime of more than 104 hours and undergo little degradation of output over time. LEDs require no filters to produce blue light, are resistant to shock and vibration, and use little power to operate.[5]

The purpose of this study was to compare the microleakage of three different composite resins, two of which have dimethacrylate monomer structures (Aelite Aesthetic Enamel and Inten-S) and one with a silorane monomer structure (Filtek Silorane) after polymerization with three different LCUs.

The first null hypothesis to be tested was that microleakage values of silorane-based composite resins would be lower than those of methacrylate composite resins. The second null hypothesis was that there would be no differences in microleakage values of composite resin restorations after polymerization with different LCUs.

Materials and methods

Forty-five caries-free, freshly extracted human third molars were selected for this study.

These teeth were extracted because of indications of pericoronitis or periodontitis, or orthodontic or prosthetic treatment reasons from 35 patients. Informed consent was received from all patients. The teeth were stored for less than 2 months in 0.5% chloramine T. Standardized class V cavities (3 mm occlusal–gingival, 3 mm mesial–distal, and 1.5 mm deep) (Fig. 1) were prepared on the buccal and lingual surfaces of each tooth using cylindrical diamond burs with a high-speed handpiece under water cooling. This resulted in the creation of 90 total class V cavities (45 buccal and 45 lingual) on the 45 teeth. The occlusal margin was located 1.5 mm coronal from the cementoenamel junction, and the gingival margin was located 1.5 mm apical from the cementoenamel junction. The same operator prepared all specimens. The teeth were randomly divided into three groups according to the type of composite resin used for restoring the preparations. After that, each composite resin group was randomly divided into three subgroups for curing with three different LCUs ($n = 5$).

In this study, two dimethacrylate-based, same-shade (A2) hybrid composites [Aelite Aesthetic Enamel (BISCO, Schaumburg, IL, USA) and InTen-S (Ivoclar-Vivadent, Schaan, Lichtenstein)], and a silorane-based composite (Filtek Silorane; 3M/ESPE, St. Paul, MN, USA) were used. Clearfil S^3 bond (Kuraray, Okayama, Japan) was applied to the cavities before they were restored with the dimethacrylate-based composites, and Silorane System Adhesive (3M/ESPE) was applied to cavities before they were restored with the silorane-based composite according to the manufacturers' recommendations. The properties of the resin composite materials and adhesive systems used in the study are respectively shown in Tables 1 and 2.

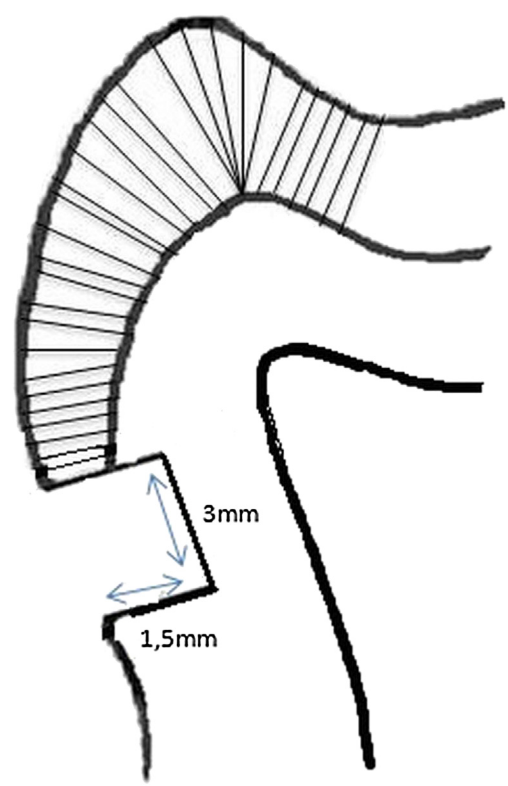

Figure 1 Schematic view of cavity configuration.