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ORIGINAL ARTICLE

Effects of chlorhexidine and gaseous ozone on microleakage and on the bond strength of dentin bonding agents with compomer restoration on primary teeth

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Abstract *Background/purpose:* The aim of this study was to evaluate microleakage and bond strength in primary tooth dentin after disinfection with chlorhexidine solution or gaseous ozone.
Materials and methods: Sixty primary first and second molar teeth without caries were collected. Thirty of these teeth were ground to expose the dentin surface and divided into three groups ($n = 10$ for each group). After the application of materials, the teeth were restored with compomer restorations. Dentin sticks were obtained from these specimens and used for the microtensile bond strength test. The effect on the microleakage of the same materials of compomer restorations was then tested. class V cavities were prepared on the facial surfaces of the remaining 30 sound primary first and second molars to which the materials were applied and that were restored with compomer. The teeth were thermocycled, stained with basic fuchsine, sectioned for microleakage evaluation, and examined under a stereomicroscope. Kruskall-Wallis, Mann-Whitney *U*, one-way ANOVA, and *post hoc* Tukey tests were used for statistical analyses.
Results: When the bond strength of the groups were compared, the difference between the ozone group and the control group was not significant ($P > 0.05$); however, the difference between the chlorhexidine group and either of the other two groups was significant ($P < 0.05$). The chlorhexidine group of teeth showed the lowest bond strength rates. When the occlusal and gingival microleakage rates among the groups were compared, the difference was insignificant ($P > 0.05$).

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Conclusion: Ozone application may be an alternative antibacterial procedure because the bond strength increased after ozone application. Chlorhexidine decreased bonding significantly. There was no significant difference between the microleakage values.

Introduction

Bacterially contaminated cavity walls associated with caries are a potential problem in restorative dentistry.[1] Bacteria can remain in the smear layer or in the dentinal tubules and can potentially multiply.[2] Studies indicate that residual bacteria may proliferate from the smear layer beneath restorations, allowing toxins to diffuse to the pulp and thereby resulting in irritation and inflammation.[1,2] It has been argued that microorganisms that are present in the cavity walls cannot be removed by using water spray or by restorative materials that contain disinfecting agents.[3] Therefore, the adjunctive use of antibacterial solutions after cavity preparation may reduce the incidence of postoperative sensitivity by eliminating viable bacteria and their toxins from the restorative interface.[4] The use of a cavity disinfectant before applying a dentin adhesive agent can reduce or eliminate postoperative sensitivity in composite restorations.[1]

Commercially available disinfectants containing compounds such as chlorhexidine digluconate, disodium ethylenediaminetetraacetic acid (EDTA) dihydrate, sodium hypochlorite, hydrogen peroxide, and iodine have been used to remove oil and bacterial contaminants. Chlorhexidine contains chlorhexidine gluconate, which binds to the amino acids in the dentin and continues to kill bacteria for several hours.[5,6] This makes it a good antimicrobial agent.[1,7,9–11] Chlorhexidine has broad spectrum activity. Gram-positive bacteria, particularly *Streptococcus mutans*, are generally more susceptible to chlorhexidine than are Gram-negative bacteria.[12,13]

These solutions are useful when used in combination with metallic restorations, but they may be less than ideal when used in adhesive techniques because they inhibit bond strength.[14–16] As an alternative approach, ozoned water or ozone gas may be used as an antimicrobial agent. Ozone application for 20 seconds effectively eliminates 99.9% of microorganisms in primary caries lesions.[17]

Ozone is an energy-rich and a highly unstable form of oxygen. It is a strong and fast oxidizer of cell walls and cytoplasmatic membranes of bacteria and is considered one of the best bactericidal, antiviral, and antifungal agents.[18] The antibacterial effect of ozone on *S. mutans* has been evaluated in several studies.[17,19–21]

To the best of the authors' knowledge, scientists have not tested whether the gaseous high-dose (2100 ppm) application of this oxidant has any negative influence on bond strength.[22] The aim of this *in vitro* study was to evaluate microleakage and bond strength in primary tooth dentin after disinfection with a chlorhexidine solution or gaseous ozone.

Materials and methods

Sixty recently extracted first and second primary molars were collected and stored at 4°C in a sterile physiological saline solution. The criteria for tooth selection included (1) an intact crown enamel and (2) lack of caries or cracks. The teeth were cleaned. They were then pumiced with a rubber prophylaxis cup and with pumice for 30 seconds. Thirty of the teeth were used for the microtensile test. The remaining thirty teeth were used for the microleakage test.

Microtensile test procedures

Tooth preparation

The occlusal enamel of 30 teeth was removed perpendicular to the long axis of each tooth by using the Isomet low-speed diamond saw (Buehler, Lake Bluff, IL, USA) under water lubrication. Grit sandpaper (numbers 240, 400, and 600) were then used to polish the dentinal surface and create a smear layer.

Experimental design

The 30 teeth selected were randomly divided into the following three groups:

- Group 1 The teeth underwent gaseous ozone (Healozone; Kavo Dental, Biberach, Germany) application for 80 seconds.
- Group 2 The teeth underwent a 2% chlorhexidine digluconate solution (Cavity Cleanser, Bisco, USA) application to the dentin for 30 seconds without being rinsed; they were then dried with absorbent paper.
- Group 3 The control group. No disinfectant was applied.

Bonding procedures

The adhesive system was applied by following the manufacturer's instructions. Prime & Bond NT (Dentsply, Caulk, Milford, Del, USA) was applied to the dentin, maintained on the surface for 20 seconds, dried for 5 seconds with oil-free air, and light cured for 10 seconds.

After the treatments were performed, 4-mm high blocks of compomer resin (Dyract Extra; Dentsply, Konstanz, Germany) were made in increments of approximately 2 mm. Each increment was light cured for 40 seconds. The teeth were then placed in distilled water at 37°C for 24 hours.

Preparation for microtensile bond testing

Microtensile testing was undertaken by using the nontrimming technique that was first described by Shono et al.[23] Each tooth was sectioned with a slow-speed saw (Isomet; Buehler, Lake Bluff, IL, USA) under water cooling into multiple beams of 0.7–1 mm^2. The cross-sectional areas and remaining dentin thickness of the selected specimens were measured by using a digital caliper that was exact to within 0.01 mm. Twenty-five beams were tested for Group 1; 24 beams, for Group 2; and 26 beams, for Group 3. The ends of each specimen were fixed to the microtensile device by