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ORIGINAL ARTICLE

Effects of ethylenediaminetetraacetic acid and sodium hypochlorite on the bond strength of bonding agents to pulp chamber lateral walls

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Abstract *Background/purpose:* The purposes of this *in vitro* study were to determine the microtensile bond strengths of four different dentin adhesive materials placed in pulp chamber walls, and to test the effects of 5% sodium hypochlorite (NaOCl) and 17% ethylenediaminetetraacetic acid (EDTA) pretreatments on resin dentin bond strengths.
Materials and methods: Recently extracted human third molars were selected. The teeth were divided into four groups. Specimens in each group were treated as follows: irrigated with distilled water; irrigated with EDTA for 5 minutes; irrigated with sodium hypochlorite for 5 minutes; and irrigated with EDTA for 5 minutes followed by NaOCl for 5 minutes. Treated specimens were dried, bonded with a total-etching adhesive, two self-etching adhesives, or a one-bottle self-etching adhesive system. After the bonding procedure and composite restoration, teeth were sectioned, and 15 dentin sticks were obtained. Microtensile testing was performed, and scanning electron micrographs were taken of each irrigated group.
Results: In the control group, the one-bottle self-etching adhesive system showed statistically higher bond strength values. EDTA irrigation did not affect the bond strength except for the total-etching adhesive. NaOCl significantly reduced the bond strengths of all adhesives. The EDTA and NaOCl combination did not show a statistically significant reduction in bond strengths of the adhesives to pulpal dentin.

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Conclusion: There was a reduction in bond strengths of all adhesive systems used to test pulp chamber lateral walls after endodontic irrigation solutions were used.

Introduction

In the past few years, increasing attention has been focused on the effectiveness of coronal sealing.[1] The success of coronal restorations has a significant effect on the outcome of root canal treatments.[2] Microorganism penetration from the coronal direction potentially contributes to failure of root canal treatment.[3] An ideal adhesive system should keep the restoration in place for a significant amount of time and must completely seal the restoration margins against the ingress of oral fluids and microorganisms.[4]

Adhesion to dentin is a challenge.[4] Dentin is a hydrated, complex, biological structure, and its properties may vary with location. The structure of dentin of pulp chamber walls differs from those of other dentinal regions of the teeth, as it includes predentin, and regular and irregular secondary dentin. The density and diameters of dentin tubules are also greater in pulp chamber walls.[5] Another distinctive point in adhesion to pulp chamber walls is the absence of a smear layer. During endodontic access, because no contemporary cavity preparation techniques are used and no cutting instruments have contacted the walls of the pulp chamber, a smear layer typically has not formed.[6,7]

The use of endodontic irrigants during root canal treatments may also cause some histological changes in pulp-chamber dentin. Sodium hypochlorite (NaOCl) and ethylenediaminetetraacetic acid (EDTA) are two of the most common irrigants employed in endodontic treatments. NaOCl is a nonspecific proteolytic agent capable of dissolving necrotic tissue remnants during irrigation,[8] whereas EDTA is generally accepted as the most effective chelating agent with prominent lubricant properties and is widely used in endodontic therapy.[9]

Another factor affecting the quality of bonding is the approach of the adhesive system. According to interactions with the smear layer and the etching technique, dentin adhesives can be grouped into two categories: total-etching and self-etching techniques. Total-etching systems aim to remove the smear layer to provide a predictable substrate for bonding, whereas self-etching systems penetrate the demineralized dentin to modify a hybrid layer that includes the dissolved smear layer.[10,11]

Additionally, the occurrence of shrinkage during polymerization creates stresses at the tooth-composite interface that may exceed the strength of any bond between the composite and enamel or dentin. Bond failure at the interface allows an influx of oral fluids.[12] In order to reduce polymerization shrinkage, a low-shrinking composite, Filtek Silorane, was introduced. So-called siloranes replaced the methacrylates in the resin matrix of dental composites.[13] The ring-opening chemistry of the resin reduces shrinkage of the composite below 1 vol%.[14] Filtek Silorane comes with a two-step self-etching adhesive, which is marketed as 'Silorane System Adhesive'. A hydrophilic self-etching primer is applied and separately light-cured prior to application of the hydrophobic adhesive resin.

The purpose of the present study was to evaluate the microtensile bond strength of total-etching [Adper Scotchbond Multi-purpose (ASB); Adper, St Paul, MN, USA] and self-etching [Adper SE Plus (ASA); Adper; Clerafil S^3 Bond (CS3); Kuraray Medical, Okayama, Japan; and Silorane Bond (SSA); Adper] adhesive systems (Table 1) to pulpal dentin surfaces treated with 5% NaOCl and 17% EDTA.

Materials and methods

Recently extracted, sound, human third molars were selected for this study. Impacted teeth were obtained from patients who visited the Department of Maxillofacial Surgery, Faculty of Dentistry, Ataturk University, Erzurum, Turkey. The patients had no systemic or oral diseases. The teeth were collected after informed consent was obtained under a protocol approved by the Ethics Committee of the Faculty of Dentistry, Ataturk University. The teeth were stored in a 0.5% thymol solution at room temperature for no longer than 2 months prior to use and were sterilized in ethylene oxide for 12 hours before sample preparation. The teeth were sectioned through the pulp chamber roof using an Isomet saw under water lubrication (Buehler, Lake Bluff, IL, USA). Pulp tissue was carefully removed without touching the inner surfaces of the pulpal wall.

Teeth were divided into four main groups: (1) non-irrigated control group (immersed in distilled water); (2) irrigated with 5% NaOCl for 5 minutes; (3) irrigated with 17% EDTA for 5 minutes; and (4) irrigated with 17% EDTA for 5 minutes followed by 5% NaOCl for 5 minutes. After irrigation, all teeth were cleaned with distilled water for 2 minutes. Specimens from these four groups were divided into four adhesive subgroups. After the cutting or sectioning process, approximately five to eight dentin sticks were obtained from each tooth. Finally, for microtensile testing, the sample size for each subgroup was 15.

The adhesive systems were applied to pulp-chamber walls according to the manufacturers' directions. Resin composites were condensed into the pulp chamber and cured in 2-mm layers on the bonded surface (Elipar Free-Light II LED; 3M ESPE, Seefeld, Germany). The output of the curing light was checked with a radiometer (Hilux UltraPlus Curing Units; Benlioglu Dental, Istanbul, Turkey). Information on the adhesive systems and composite resins used in this study is given in Table 1.

All restored specimens were immersed in distilled water at 37°C. After 24 hours, the teeth were vertically separated using the Isomet saw, and samples were fixed to a