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ORIGINAL ARTICLE

Effect of endodontic sealers on bond strength of restorative systems to primary tooth pulp chamber

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Abstract *Background/purpose:* Although current literature suggests that root canal sealers affect the bonding ability of restorative systems to pulp chamber dentin of permanent teeth, primary teeth have not been investigated. This study intended to evaluate the microtensile bond strength (μTBS) of three restorative systems to pulp chamber dentin in primary teeth and to determine the effect of two different root canal sealers on the μTBS.
Materials and methods: Ninety primary molars were used in this study. The teeth were randomly divided into three main groups according to canal sealers: (1) control (without sealer); (2) Metapex; and (3) zinc-oxide eugenol. The main groups were further divided into three subgroups depending on the coronal restorative system: (1) compomer (Prime Bond NT + Dyract EXTRA); (2) composite (Clearfil Tri-S Bond + Clearfil Photo Posterior); and (3) resin-modified glass ionomer (Fuji II LC). After restoration, the buccal wall of the pulp chamber was sectioned to obtain sticks (1 mm × 1 mm). The μTBS was then measured. Data were analyzed with two-way analysis of variance, followed by a *posthoc* test. The interfacial morphology of the bonded space was evaluated using scanning electron microscopy.
Results: In the control group, a significant difference was observed only for the μTBS of the composite ($P < 0.05$). Compared with the control groups, Metapex and zinc-oxide eugenol significantly reduced the μTBS of restorative systems ($P < 0.05$).
Conclusion: Composite materials seemed to bond to pulp chamber dentin in primary teeth with a higher strength than compomer and resin-modified glass ionomer. Metapex and zinc-oxide eugenol canal filling materials reduced the bond strength of all three restorative systems.

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Introduction

The importance of coronal filling for the success of endodontic treatment has previously been reported by many researchers.[1,2] Suitable coronal restoration of endodontically treated teeth should provide esthetic and functional value, a sound remaining tooth structure, and prevent microleakage.[3] As the presence of accessory canals may lead to inflammatory changes in the periodontal tissues because of the direct transition of microorganisms from the pulp chambers to the furcation area, coronal microleakage may be a clinical problem, especially in multirooted primary teeth.[4]

Stainless steel crowns have long been considered the gold standard for the final restoration of endodontically treated primary molars, assuming that full-crown coverage may prevent leakage.[5–7] However, the demand for a more esthetic alternative has increased for adults and children alike in recent years.[8] Studies on the efficacy of tooth-colored and bonded restorations in endodontically treated primary molars have shown promising results with alternative materials.[9,10] Composites, glass ionomers, or some combination of these, such as resin-modified glass ionomers (RMGIs) and compomers, are being increasingly used in pediatric restorative dentistry.[11] These materials bond directly to the tooth structure and reinforce it as an endodontically treated tooth that usually requires extensive restoration.[12]

Ideal bonding of restorative material to the tooth structure must mimic the natural enamel–dentin connection.[13] Adhesive materials must come into intimate contact with the substrate (adherend) to perform chemical adhesion or micromechanical locking.[13,14] One of the factors that affect this intimate contact is the wetting ability of adhesives; this means that the surface tension value of an adhesive should be smaller than the surface free energy of the adherend. The other factor is the contact angle of the adhesive to the adherend; this angle has an inverse relationship with wettability, meaning that the lower the contact angle, the greater the wettability, and hence, the greater the adhesion.[13–15] Accordingly, adhesion may be affected by the structural and physicochemical features of the restorative material, as well as tooth properties and environmental factors.

Compared with the enamel, bonding to normal dentin is a greater challenge because of its organic constituents, fluid-filled tubules, and variations in intrinsic compositions.[13–17] Endodontic treatment increases this challenge by two or three times because the pulp chamber, which constitutes the adhesion area, has structural and compositional differences from coronal dentin. Compared with coronal dentin, pulp chamber dentin has tubules with a larger diameter, creating a wetter structure, which negatively affects adhesion.[18,19] Furthermore, endodontic irrigants or root canal filling materials can adversely affect the bonding of adhesives to pulp chamber dentin. This happens either by inhibiting polymerization of resins at the dentin–adhesive interface or by changing the mechanical and physical properties of dentin itself.[20–22] Although some studies have evaluated the bonding ability of restorative systems to pulp chamber dentin in permanent dention,[18–22] to the best of our knowledge, no published study has evaluated the adhesion of restorative systems to pulp chamber dentin in primary dentition. Therefore, the aim of the present study was to evaluate the microtensile bond strength (μTBS) of three adhesive restorative materials to pulp chamber dentin in primary teeth: (1) composite, Clearfil Tri-S Bond + Clearfil Photo Posterior (self-etch); (2) compomer, Prime Bond NT + Dyract EXTRA (total etch); and (3) RMGI, GC, Fuji II LC. We also determined the effect of two different root canal sealers [Cavex zinc-oxide eugenol (ZOE) and Metapex] on the bond strength of restorative materials.

Materials and methods

The study protocol was approved by the Ethics Committee of Selçuk University. Ninety extracted human primary second molar teeth were used in this study. Recently extracted primary molars were collected and stored at 4°C no longer than 2 months prior to use after extractions. The reasons of the extraction (retained primary teeth, ankyloses, etc.) were not related to this study. The criteria for the selection of teeth from the collection included: (1) lack of caries; and (2) at least two to three intact roots.

The roofs of the pulp chambers were removed using an Isomet saw (Isomet Low Speed Saw; Buehler Ltd, Lake Bluff, IL, USA; Figure 1A). Pulp tissue was removed carefully with a spoon excavator and endodontic instruments. The working length was set at 1 mm from the apical foramen. Mechanical hand preparation was performed based on the routine root canal preparation principles of primary teeth with H-files (Mani Inc., Tochigi, Japan) no greater than size 30.[23] Irrigation was performed with 2 mL of 2.5% NaOCl after using each instrument. After completion of root canal preparation, the teeth were randomly divided into three main groups, including 30 teeth, according to the root canal filling material.

Group 1: Control group. The root canal was not sealed with a root canal material, and root canal orifices were obturated with a thin traditional glass ionomer material (Argion Molar; Voco, Cuxhaven, Germany).

Group 2: The root canal was obturated with Metapex (Meta Biomed Co. Ltd, Cheongju, Korea; combination paste of iodoform and calcium hydroxide) using the lentulo spiral technique. The remnant sealer on the wall of the access cavity was cleaned with an excavator and a cotton pellet with alcohol.[24] Alcohol was applied for approximately 1 minute until the surface appeared visibly clean. Then the surface was cleaned three times with saline using cotton pellets. After cleaning, the root canal orifices were obturated with a thin traditional glass ionomer coat as in Group 1.

Group 3: Cavex ZOE (Cavex Holland BV, Haarlem, Netherlands) was used for obturation of the root canal using the lentulo spiral technique. The access cavity was cleaned following the same protocol used in Group 2.

After completion of the root canal sealing, the three main groups were divided into three subgroups according to the coronal restorative system used, randomly including 10 teeth.