The Influence of AH-26 and Zinc Oxide-Eugenol Root Canal Sealer on the Shear Bond Strength of Composite Resin to Dentin

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ABSTRACT

The purpose of this study was to evaluate the influence of the AH-26 root canal sealer on the shear bond strength of composite resin to dentin.

One hundred and forty four (144) extracted, sound human molars were used. After embedding in a cylindrical mold, the occlusal part of the anatomical crown was cut away and trimmed in order to create a flat dentin surface. The teeth were randomly divided into three groups; the AH-26 sealer was applied to the AH-26 group, and zinc-oxide eugenol (ZOE) paste was applied to the ZOE group. The dentin surface of the control group did not receive any sealer.

A mount jig was placed against the surface of the teeth and the One-step dentin bonding agent was applied after acid etching. Charisma composite resin was packed into the mold and light cured. After polymerization, the alignment tube and mold were removed and the specimens were placed in distilled water at 37℃ for twenty four hours. The shear bond strength was measured by an Instron testing machine. The data for each group were subjected to one-way ANOVA and Tukey's studentized rank test so as to make comparisons between the groups.

The AH-26 group and the control group showed significantly higher shear bond strength than the ZOE group ($p < 0.05$).

There were no significant differences between the AH-26 group and the control one ($p > 0.05$).

Under the conditions of this study, the AH-26 root canal sealer did not seem to affect the shear bond strength of the composite resin to dentin while the ZOE sealer did. Therefore, there may be no decrease in bond strength when the composite resin core is built up immediately after a canal filling with AH-26 as a root canal sealer. (J Kor Acad Cons Dent 31(3):147-152, 2006)

Key words : AH-26, ZOE sealer, Root canal sealer, Shear bond strength to dentin, Composite resin core

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I. INTRODUCTION

Successful final restoration is important for the long term success of root canal treatment. A lack of adhesion in a final restoration could result in apical or coronal leakage that causes problems in the root canal treatment[1,2]. Endodontically-treated teeth frequently require extensive restorations with post-core system[3,4].

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Since composite resin bonds to the structure of teeth, it can reinforce the structure[5], and composite resin, along with the dentin bonding agent, was able to restore the access cavity or build the core in endodontically-treated teeth.

When composite resin is used as a restorative material after root canal filling, the residual sealer may come into contact with the resin adhesive, which may influence its adhesive properties. It has been shown that some endodontic materials can interfere with the adhesion of composite resin[6-11]. A zinc oxide-eugenol (ZOE)-based sealer reduced post retention whereas a resin-based and a calcium hydroxide-based sealers did not affect post retention significantly, as compared to that without a sealer[4]. An epoxy resin sealer showed no significant differences when comparing the tensile or compressive strength of composite resin restoration[12].

More research is needed regarding the influence of a root canal sealer on the bond strength of composite resin restoration. Therefore, the purpose of this study was to evaluate the influence of root canal sealers on the shear bond strength of composite resin on dentin, after the mechanical removal of the sealer[13-15].

Ⅱ. MATERIALS AND METHODS

The preparation of the teeth

One hundred and forty four (144) extracted, sound human molars, that had been stored in isotonic saline at 4℃, were used in this study. The teeth were cleaned with a 1% NaOCl solution, in order to remove soft tissue debris, and the teeth were embedded in cylindrical molds with self-curing acrylic resin (Orthodontic Resin, Dentsply/Caulk, Milford, DE, USA) up to the cemento-enamel junction. One-third to one-half of the occlusal part of the anatomical crown was cut away with a low-speed diamond disc, in order to expose the dentin. The exposed dentin was trimmed on a water-cooled model trimming wheel in order to create a flat surface. The trimmed surface was ground with 180- and 400-grit silicon carbide abrasive papers.

The application of the root canal sealer

The teeth were randomly divided into three groups: the AH-26 sealer group, the ZOE sealer group, and the control group (no sealer). The AH-26 sealer (Dentsply/De Trey, Konstanz, Germany) was mixed according to the instructions by the manufacturing company and the ZOE sealer was made by mixing zinc oxide powder (Duksan Pure Chemical Co. Ltd, Ansan, Korea) with eugenol liquid (Sultan Chemists, Inc. Englewood, NJ, USA, Table 1) on a glass slab, with a weight ratio of 2.07 : 1.00 in order to have a thick creamy consistency[16]. In the AH-26 group and the ZOE group, a thin layer of the corresponding sealer was applied for 15 min. The sealers were removed by scrubbing the dentin surface with a dry cotton pellet. The dentin surface of the control group was left as is (no sealer).

The bond strength test

A mount jig (Ultradent Product Inc., South Jordan, Utah, USA), with an internal ring of 2.3798 ㎜ in diameter and a height of 2.0 ㎜, was placed against the tooth surface and stabilized by an alignment tube[17,18]. The dentin surfaces were etched with 32% phosphoric acid for 15 sec, rinsed with water for 15 sec, and blot dried. The One-Step® dentin bonding agent (Bisco, Inc., Schaumburg, USA) was applied twice with light curing for 10 sec each application. This was followed by the packing the Charisma composite resin (Heraeus Kulzer, Inc., Hanau, Germany) and light curing for 20 sec.

After resin polymerization, the alignment tube and mold were removed, and the specimens were placed in distilled water at 37℃ for 24 hours. The specimens in each group were tested in a shear mode by using a chisel-shaped rod in an Instron testing machine (Model 4202, Instron Corp., Canton, Massachusettes, USA) at a crosshead speed of 1 ㎜/minute[19] (Figure 1).

Table 1. Composition of the materials used in the study

Product Name	Manufacturer	Composition
One-Step Dentin Bonding Agent	Bisco, Inc. Schaumburg, USA	Bis-phenol A diglycidylmethacrylate (Bis-GMA), 2-hydroxyethyl methacrylate (BPDM), Acetone
AH-26 Root Canal Sealer	Dentsply/De Trey, Konstanz, Germany	Powder: Bismuth(III)oxide 0.80 g/g, Methenamide 0.20 g/g Resin: Bisphenol-A-diglycidylether 1.0 g/g
Zinc Oxide	Duksan Pure Chemical Co. Ltd, Ansan, Korea	Powder: Zinc Oxide
Eugenol, USP	Sultan Chemists, Inc. Englewood, NJ, USA	Liquid: Eugenol

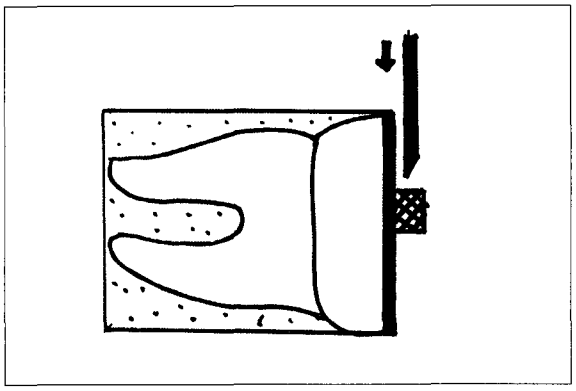

Figure 1. Schematic diagram of the specimen for the shear bond test.

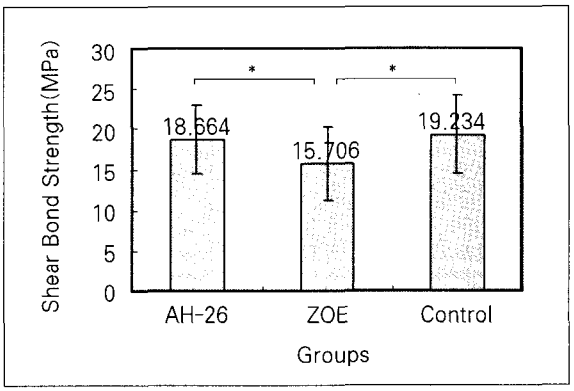

Figure 2. Shear bond strength of composite resin to dentin (Mean ± S.D.).
* Statistically significant ($p < 0.05$).

The data for each group were subjected to a one-way ANOVA and Tukey's studentized rank test in order to make comparisons between the groups ($p < 0.05$).

Ⅲ. RESULTS

The results of the shear bond strength test are shown in Figure 2.

The AH-26 group and the control group showed significantly higher shear bond strength than the ZOE group ($p < 0.05$).

There was no significant difference between the control group and the AH-26 group ($p > 0.05$).

Ⅳ. DISCUSSION

The results of the present study showed that canal filling materials can affect the bonding of composite resins and the dentin bonding agent to dentin[20-23]. It is known that resin polymerization can be affected by reducing agents such as phenolic compounds like eugenol[24,25]. Reducing agents may inhibit the adhesion of the adhesive restoration system based upon a vinylic polymerization mechanism. In the present study, the ZOE sealer treated-dentin showed a less bond strength than the untreated dentin. The results of the present study support this hypothesis.

Although eugenol does not affect on the bond

strength of composites on enamel, contradictory finding exist regarding the effect of eugenol on the bond strength on dentin. While some researches[9,11,24,25] have found that pre-treatment with eugenol containing-temporary cements decreases bond strength of composites on dentin, other researches have found otherwise[5,6,8,10,11].

In contrast to eugenol, epoxy resin does not interact with the free-radical initiation for the composite resin. As a result, no interruption of the setting reaction occured in the present study. AH-26 has epoxy resin polymer chemistry. For epoxy resin, there is an opening of the epoxy monomer ring that results in a final polymer matrix, which contains free (-OH) groups. Since the final epoxy matrix contains a free hydroxyl group, bonding to the free radical, produced in the initiation stage of the setting reaction for the composite resin, is possible. A review of literature[12,26], however, indicates that the opening of the epoxy monomer ring takes many hours, even days, whereas a full cure of the composite resin can be achieved in several minutes. Therefore, by incorporating AH-26 into the final polymer matrix of the composite resin, it does not participate chemically in the setting reaction[12].

In the present study, the AH-26 treated dentin showed a similar bond strength to the untreated one, and a higher bond strength than the ZOE sealer-treated one.

It was hypothesized that the current dentin-bonding systems effectively remove residual cement and eugenol-contaminated dentin and consequently, are insensitive to pre-treatment with eugenol-containing temporary restorations[9]. In the case of the AH-26 treated group, we can hypothesize that the effects of AH-26 do not seem to be strong enough to alter tensile strength. One may hypothesize the following: that contaminants remain on the dentin surface after cleansing; that they were soluble in the core material; and that they did not interfere with polymerization. A second possible explanation is that most or all of the contaminants on the surface were removed by the etching and bonding procedures. A third plausible explanation could be that the etchant used by the One-step adhesive system dissolved the remaining contaminants, thus eliminating their potential in reducing bond strength[27]. The clinical significance of this theory, however, it is questionable.

On the other hand, the AH-26 group showed significantly higher values than the ZOE-treated group. The AH-26 group didn't show any significantly different values as compared to the control group.

These results should be kept in mind when selecting appropriate materials regarding composite resin core build up. Insufficient debridement of a eugenol-based material from the dentinal surfaces may affect the quality, retention, and strength of the composite resin core build-up. In order to avoid these problems, it is better to use a material that does not contain eugenol, such as an epoxy resin root canal sealer.

Therefore, in conclusion, our study showed that the epoxy resin sealer AH-26 seemed to have no significant adverse effect on the shear bond strength of composite resin on dentin, while the ZOE sealer did show such effects.

When composite resin restoration is planned after root canal treatment, it may be desirable to use the AH-26 as a root canal sealer from the standpoint of shear bond strength. Further study is necessary to evaluate the effect of the AH-26 on the dentin bonding within a clinical environment.

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국문초록

AH-26 및 산화아연유지놀 근관실러가 상아질에 대한 복합레진의 전단결합강도에 미치는 영향

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AH-26 근관실러가 상아질에 대한 복합레진의 전단결합강도에 미치는 영향을 평가하기 위하여 144개의 발거된 대구치를 실린더형의 몰드에 매식한 다음 치관부의 상아질 표면을 노출시킨 후 편평하게 연마하고 AH-26을 도포한 군, ZOE paste를 도포한 군 및 실러를 도포하지 않은 대조군으로 나누어 One-step 상아질 접착제를 처리한 후에 Charisma (Heraeus Kulzer, Germany) 복합레진을 적용하고 광중합시켰다. 시편을 분리하여 37℃ 항온조에 24시간 보관후 Instron test machine (Model 4202, Instron Corp., USA)을 이용하여 시편의 전단 결합강도를 측정하고 one-way ANOVA 및 Tukey's studentized rank test로 통계 분석하였다.

AH-26 근관실러로 처리한 군과 대조군은 ZOE 근관실러 처리군에 비해 유의하게 높은 접착강도를 나타내었다 ($p < 0.05$).

AH-26 근관실러 처리군과 아무 처리하지 않은 대조군 사이에는 결합강도에 있어 유의한 차이를 나타내지 않았다 ($p > 0.05$).

본 연구의 조건에서는 ZOE 근관실러는 상아질에 대한 복합레진의 전단결합강도를 저하시키는 반면 AH-26 근관실러는 유의한 영향을 미치지는 않는 것으로 보인다. 따라서 임상에서 근관실러로 AH-26을 사용한 근관충전 후에는 즉시 복합레진 코어를 해 주어도 결합력에 저해가 없을 것으로 여겨진다.

주요어: AH-26, ZOE 실러, 근관실러, 전달결합강도, 복합레진 코어, 상아질 접착