Journal of Dental Sciences (2015) 10, 270—274

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-jds.com

ORIGINAL ARTICLE

Effect of simplified ethanol-wet bonding on microtensile bond strengths of dentin adhesive agents with different solvents

Muhammet Kerim Ayar*

Department of Restorative Dentistry, Faculty of Dentistry, Karadeniz Technical University, 61000 Trabzon, Turkey

Received 7 January 2013; Final revision received 13 March 2013
Available online 22 July 2014

KEYWORDS
dentin bonding;
ethanol;
microtensile bond strength;
wet bonding

Abstract *Background/purpose:* Available knowledge about the effect of solvent-type etch-and-rinse adhesives on dentin bond strengths achieved with ethanol-wet bonding is limited. Therefore, this study was conducted to determine 24-hour bond strengths of etch-and-rinse adhesives with different solvents to acid-etched dentin saturated with either water-wet bonding or ethanol-wet-bonding techniques.
Materials and methods: Sixteen bovine incisors were divided into the following four groups based on the bonding techniques and adhesives used: Group I, water-wet bonding + Single Bond 2 (water/ethanol-based adhesive); Group II, water-wet bonding + Prime & Bond NT (acetone-based adhesive); Group III, ethanol-wet bonding + Single Bond 2 (water/ethanol-based adhesive); and Group IV, ethanol-wet bonding + Prime & Bond NT (acetone-based adhesive). After etching and rinsing, dentin surfaces were either left moist with water or immersed in ethanol. Following adhesive application and composite buildups, bonded teeth were sectioned into resin—dentin sticks for microtensile bond strength testing, which was conducted after storing the sticks in water for 24 hours. Data were analyzed by two-way analysis of variance and Tukey test ($P = 0.05$).
Results: Mean bond strength values (MPa) and standard deviations at 24 hours were as follows: Group I, 34.41 (12.6); Group II, 41.62 (11.8); Group III, 43.52 (13.8); and Group IV, 41.68 (9.1). No significant difference in bond strength was observed between different bonding techniques for both adhesives ($P > 0.05$).
Conclusion: Simplified ethanol-wet bonding exhibited similar 24-hour bond strength mean values for both ethanol/water-based and acetone-based etch-and-rinse adhesives. Therefore, solvent content may not interfere with bond strength to ethanol-saturated dentin.

* Department of Restorative Dentistry, Faculty of Dentistry, Karadeniz Technical University, Kanuni Campus, 61000 Trabzon, Turkey.
E-mail addresses: kerimayar@ktu.edu.tr, mkayar82@gmail.com.

http://dx.doi.org/10.1016/j.jds.2014.06.001

Introduction

Resin composite restoratives are able to bond to enamel and dentin through the use of dentin adhesive agents. Dentin adhesive agents are basically a blend of hydrophobic and hydrophilic resin monomers, solvents, cosolvents, photoinitiators, and inhibitors.[1] Bonding mechanism of the current etch-and-rinse adhesive agents to dentin is supposed generally as a mechanical interlocking.[2] Acid etching of smear layer-covered dentin surfaces results in the removal of smear layers and demineralized dentin matrices in which the mineral content of dentin is replaced with water. When adhesive blends containing resin monomers with both hydrophilic and hydrophobic groups are applied onto acid-etched dentin surfaces, resin monomers infiltrate into demineralized dentin matrices, impregnate interfibrillar spaces around collagen fibrils, encapsulate collagen fibrils, displace water, polymerize, and create interlocking with acid-etched dentin, respectively. Consequently, this process—dentin hybridization—provides mechanical retention for resin composite restoratives that chemically bond to adhesive resin.[2]

It is accepted that achieving ideal dentin hybridization depends on preventing the collapse of demineralized dentin matrices, or in other words, keeping interfibrillar spaces open as these play a role as infiltration pathways for adhesive resin monomers. When demineralized dentin matrices are saturated with water, maximum openings in interfibrillar spaces are obtained.[3] However, adhesive resin monomers have limited capability to displace water from interfibrillar spaces, and therefore, different solvents (e.g., ethanol and acetone) are used as ingredients in adhesive formulations to effectively displace water from resin–dentin interfaces prior to polymerization of adhesive resin. Nevertheless, under clinical conditions, the current solvent-type etch-and-rinse adhesives are not able to displace enough water from interfaces, which is necessary to achieve ideal dentin hybridization.[4,5] Residual water within interfaces reduces durability of the resin–dentin bonding due to hydrolytic and enzymatic degradation of dentin hybrid layer components over time, and thus jeopardizes longevity of adhesive restoration.[5]

A novel wet-bonding technique called "ethanol-wet bonding" was recently introduced to improve the durability of the resin–dentin bonding.[6] Unlike the conventional water-wet-bonding technique, the ethanol-wet-bonding method uses ethanol instead of water to saturate and prevent the collapse of demineralized dentin matrices prior to resin application. This means that water is replaced from interfibrillar spaces with ethanol during saturation of demineralized dentin matrices with ethanol prior to the application of the adhesive agent.[3] The rationale behind this is that miscibility of adhesive resin monomers in the ethanol-saturated dentin matrices is better than those in the water-saturated dentin matrices, and thus ethanol as a saturation solvent for demineralized dentin matrices may allow intimate encapsulations of collagen fibrils with adhesive resin monomers. Consequently, this technique can provide more ideal hybrid layers.[7] Therefore, ethanol-wet bonding may diminish enzymatic degradation of collagen fibrils and improve durability of resin–dentin bonds.

The current etch-and-rinse adhesive systems are formulated to be compatible with the water-wet-bonding technique.[8] Hence, they contain both hydrophobic (i.e., bisphenol A–glycidyl methacrylate) and hydrophilic monomers (i.e., hydroxyethyl methacrylate), which are well miscible in ethanol than in water.[3] Therefore, it is possible that the current adhesive resins may provide improved penetration with ethanol-wet bonding.[9] However, available knowledge on the effect of different solvent contents of current etch-and-rinse adhesives on bonding strength achieved with ethanol-wet bonding is scarce in the literature.

This study was conducted to determine the effects of different solvent contents of two etch-and-rinse adhesives [Single Bond 2 (3M ESPE, St. Paul, MN, USA), a water/ethanol-based adhesive, and Prime & Bond NT (DENTSPLY De Trey, Konstanz, Germany), an acetone-based adhesive] on microtensile bond strengths (μTBSs) to dentin with ethanol-wet bonding and compare the results obtained using these agents with water-wet bonding. The null hypothesis tested was that different solvent contents will not affect the bond strength of tested adhesives to dentin with ethanol-wet bonding.

Materials and methods

Sample preparation

In this study, 16 bovine incisors, collected from bovines that were at least 2 years old, were used. Teeth were stored in 0.02% sodium azide solution at 4°C for a maximum period of 6 months prior to use. Soft tissues around teeth were scalped and roots were removed using low-speed diamond disk under water. Crowns were embedded into self-cure acrylic blocks using a double-sided adhesive band. Enamel surfaces were ground using 320-grit silicon carbide papers to obtain flattened surfaces. The box-shaped cavities were prepared on exposed enamel surfaces using a coarse diamond bur with high-speed turbine. Prepared samples were randomly divided into the following four groups ($n = 4$) based on the adhesives and bonding techniques used: Group I: Single Bond 2 (water/ethanol-based adhesive) + water-wet bonding; Group II: Prime & Bond NT (acetone-based adhesive) + water-wet bonding; Group III: Single Bond 2 (water/ethanol-based adhesive) + ethanol-wet bonding; and Group IV: Prime & Bond NT (acetone-based adhesive) + ethanol-wet bonding.

Bonding procedures

Dental adhesives were used according to the manufacturer's instructions in the water-wet-bonding groups (Groups I and II; Table 1). In the ethanol-wet-bonding groups (Groups III and IV), the simplified ethanol-wet-bonding technique was used.[10] This technique presented a simplified way of ethanol dehydration of demineralized dentin matrices. The method involves saturation of acid-etched dentin surfaces with absolute ethanol using a needle for 1 minute. Surfaces should be kept visibly wet with ethanol during this period and adhesives should then be applied to these ethanol-saturated surfaces according to