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A prospective 8-year evaluation of a mild two-step self-etching adhesive and a heavily filled two-step etch-and-rinse system in non-carious cervical lesions

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ABSTRACT

Objectives. The aim of this study was to evaluate the long-term clinical retention to dentin of a two-step self-etching adhesive system Clearfil SE Bond and a two-step etch-and-rinse system PQ1.

Methods. A total of 119 Class V restorations were placed in non-carious cervical lesions without intentional involvement of the enamel incisal of the lesions. The restorations were evaluated yearly during an 8-year follow-up. Clinical dentin bonding efficiency was determined by the percentage of lost restorations at each of the recalls.

Results. At 8 years, 112 restorations could be evaluated. Both adhesives fulfilled the ADA 18-month full acceptance criteria for retention with a retention rate of 90.6% for PQ1 and 98.2% for Clearfil SE Bond. The loss rates increased then considerably after 2 and 3 years, respectively. The cumulative loss rates at 8 years were 25.5% for Clearfil SE and 39.3% for PQ1 ($p = 0.12$). No significant differences were observed between lesions with sclerotic and non-sclerotic dentin. The size of the lesions did not influence the bonding effectiveness. A lower loss rate was found for the restorations placed in lesions slightly roughened before etching.

Conclusion. Both adhesive systems showed acceptable short-term clinical retention to dentin, which decreased after long-time in vivo aging, especially for the simplified etch-and-rinse system.

1. Introduction

In adhesive dentistry bonding to the tooth tissues is usually based on the replacement of tooth minerals, removed by acid etching, by low viscous resin monomers. After curing of the resins, a strong micro-mechanical bond is created by interlocking of the monomers in the tooth surface creating a hybrid layer. Adhesive techniques have been improved substantially during the last decades and are now involved in most of the clinical procedures. Enamel–resin bonds, produced after acid etching with phosphoric acid have shown to be satisfactory and stable over time [1,2]. Adhesion to dentin on the other hand has been difficult to achieve and less durable [3–5]. The introduction of primers containing amphiphilic monomers, dissolved in solvents like water, acetone or alcohol to promote wetting of the dentin and replace water, changed dentin bonding to a more reliable clinical procedure. Two alternative strategies are used to obtain the bond. Etch-and-rinse adhesives, which pretreat the smear layer and the underlying tooth

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tissues with phosphoric acid followed by the application of a primer and an adhesive in two steps or one step. In the second approach, the self-etching adhesives (SEA) or etch-and-non-rinse systems are the acid and the primer combined into one step. This is followed by the application of the adhesive in the two-step SEA, while in the one-step SEA, all components are included in one step, as two-bottles or one-bottle systems. The SEA simultaneously self-etch and infiltrate the dental tissues. They are supposed to make the bonding procedure more user-friendly, eliminating the risk of over-etching and over-drying. In two-step self-etching adhesives there is a separate priming step with more hydrophilic monomers and a more hydrophobic bonding step. SEA are either mild or strong. A strong self-etch approach is more favorable for the bond to enamel. Mild etching systems give better bonding to the dentin, but demineralize enamel less effectively than traditional phosphoric acid (that needs to be rinsed of). The hybrid layer of the SEA is much thinner compared to the traditional etch-and-rinse systems. The immediate bonding effectiveness of many simplified systems has been quite favorable both in the laboratory and in short-time evaluations [7–10]. Due to their high content of hydrolytical components and increased permeability of the hybrid layer, the bonds with SEA appear more vulnerable to degradation in the mouth [11]. Among the self-etch adhesives, the two-step adhesive Clearfil SE Bond has been associated with favorable laboratory and short-time clinical results [8,12–14]. Clinical evaluations investigating the long-time effectiveness of self-etch systems are sparse [5,6]. Studies have shown that filled adhesives could act as stress buffers, relieving polymerization stresses that occur at the interface between tooth substance and resin composite, thus improving interfacial adaptation.

The aim of this study was to investigate the clinical dentin bonding effectiveness of a mild two-step self-etching system and a heavily filled two-step etch-and-rinse adhesive including a natural resin. The hypothesis tested was that there was no difference in clinical long-term retention to dentin between the self-etching system and the etch-and-rinse adhesive.

2. Materials and methods

A total of 119 class V restorations were placed in 72 patients (30 men and 42 women) with a mean age of 60.1 years (range 42–84), for whom treatment of non-carious cervical lesions was indicated. One experienced operator, familiar with adhesive dentistry placed the restorations in dentin lesions without any intentional involvement of the enamel incisal of the lesion. This in order not to enlarge the retention area. Seventy restorations were placed in premolars, nine in molars and 40 in incisors/cuspidates. Sixty-five lesions were placed in the maxilla and the others in the mandibula.

Table 1 – The relative frequencies of Class V non-carious lesions investigated, degree of sclerotic dentin, depth and size of lesions and number of roughened lesions before conditioning.

Class V lesion	Clearfil SE	PQ 1
No.	55	64
Non-sclerotic lesions	22.0	15.7
<50% sclerotic tissue	14.6	25.5
>50% sclerotic tissue	63.4	58.8
Shallow	61.0	58.8
Moderate depth	12.2	13.7
Deep	26.8	27.5
Small sized	24.3	31.4
Moderate	36.6	27.5
Large	39.0	41.2
Roughened lesions	63.4	51.0

Pre-operatively, the lesions were categorized by the operator compared to lesion models in terms of depth (shallow, moderate, deep) and size (small, moderate, deep) of the lesion, the area of the dentin surface estimated as sclerotic tissue (none, <50%, >50%), and after randomization of the lesions these were roughened or not by diamond bur before application of the adhesive system (Table 1) [3]. The lesions were filled in randomly order by two adhesive systems. The two-step etch-and-rinse adhesive PQ1, which is heavily filled with fluoride-releasing radiopaque filler (40%) (Ultradent, USA) was applied with the hybrid resin composite Tetric Ceram (Ivoclar/Vivadent, Schaan, Liechtenstein). The mild two-step SEA (Clearfil SE Bond, Kurary, Tokyo, Japan; Lot 51137) was used in combination with the nano-filled hybrid resin composite Point 4 (Kerr Corp., Orange, USA). The operative field was isolated with cotton rolls and a saliva suction device. Before conditioning, the lesions were cleaned pre-operatively

Table 2 – Composition and handling of the bonding systems.

Adhesive system	Composition	Treatment	Manufacturer
Clearfil SE Bond	*Primer*: 10-MDP (10-methacryloyloxydecyl dihydrogen phosphate), HEMA, Bis-GMA, hydrophilic dimethacrylate (DMA), DET (N,N-diethanol-p-toluidine), water, camphoroquinone, N,N-diethanol-p-toluidine pH 1.9	P: 20 s, gently air stream to evaporate the volatile ingredients.	Kurary Co. Ltd., Osaka, Japan/Cavex, Holland
	Bonding resin: 10-MDP (10-methacryloxydecyl dihydrogen phosphate), HEMA, hydrophobic dimethacrylate, Bis GMA, silanated colloidal silica, DET (N,N-diethanol-p-toluidine), camphorquinone	B: brush, light cure 20 s	Lot number 41116
PQ 1	*Conditioner*: 35% phosphoric acid	C: 15 s, rinse, dry gently	Ultradent, South Jordan, UT, USA
	Primer/adhesive: Canadian balsam (tree sap), 15% HEMA, TEGDMA, 40% filler with fluoride, ethanol camphorquinone, phosphate monomer	P/A: 20 s agitate, air blow, light cure 20 s	