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Long-term dentin retention of etch-and-rinse and self-etch adhesives and a resin-modified glass ionomer cement in non-carious cervical lesions

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ABSTRACT

Objectives. The aim of this study was to evaluate the clinical long-term retention to dentin of seven adhesive systems.

Methods. A total of 270 Class V restorations of four etch-and-rinse, one self-etch adhesive system and a resin-modified glass ionomer cement were placed in non-carious cervical lesions without intentional enamel involvement. The restorations were evaluated at baseline, 6, 12, 18, and 24 months and then every year during a 13-year follow-up. Dentin bonding efficiency was determined by the percentage of lost restorations.

Results. During the 13 years, 215 restorations could be evaluated. The cumulative loss rate at 13 years was 53.0%, with significant different failures rates for the different systems varying between 35.6 and 86.8%. Four systems fulfilled the ADA 18-month full acceptance retention criteria. Two systems showed at 18 months and earlier high debonding rates. The annual failure rates for the etch-and-rinse systems were Optibond 3.1%, Permagen 13.0%, Scotchbond MP 4.8%, Syntac classic 2.8%; for the self-etch system P&S 4.4%; and the resin-modified glass ionomer cement Vitremer 2.7%.

Conclusion. It can be concluded that all systems showed a continuous degradation of the bond with a wide variation, which was independent of the adhesion strategy. Three bonding systems showed a cumulative failure rate after 13 years between 36 and 41% with the best retention for the resin-modified glass ionomer cement and a four-step etch-and-rinse system.

1. Introduction

Most procedures in operative dentistry involve day-to-day adhesive techniques. The introduction of amphiphilic monomers, dissolved in solvents such as water, acetone or alcohol, made the bond to dentin more reliable and improved clinical retention [1–4]. The monomers infiltrate moist dentin surfaces and create a molecular entanglement network with the collagen fibrils resulting in high micromechanical bonds. The exposed collagen fibrils are susceptible to hydrolytic degradation in the wet oral environment, and reduction of bond strength due to degradation of the resin–dentin bond has been observed in the laboratory and in vivo [5–8]. Clinical bonding effectiveness can be demonstrated in non-carious

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cervical lesions located mainly in dentin, in which no cavity preparation or macro-mechanical retention is used. Unfortunately, most of these published trials are of limited durability, and more information about the clinical performance over a significant period of time is necessary [8,9]. Recently, a large variation in clinical long-time dentin bonding effectiveness was shown between adhesive systems, independent of adhesion strategy [8]. The purpose of this study was to present the long-term clinical effectiveness of four etch-and-rinse, one self-etch bonding system, and a resin-modified glass ionomer cement in non-carious cervical lesions.

2. Materials and methods

A total of 270 Class V restorations were placed in 88 patients (46 men and 42 women) with a mean age of 56.7 years (range 28–83), for whom treatment of non-carious cervical lesions was indicated. All restorations were placed in dentin lesions, without any intentional enamel involvement, by one experienced operator who was familiar with adhesive dentistry. The following adhesive systems were successively investigated as they became available in different time periods: three three-step etch-and-rinse systems: Optibond ($n=44$), Permagen ($n=41$), Scotchbond Multi-Purpose ($n=43$); one four-step etch-and-rinse system: Syntac classic ($n=47$); a one-step self-etch system: PSA ($n=46$) and a resin-modified glass ionomer cement Vitremer ($n=49$) (Table 1).

Before conditioning, the lesions were cleaned preoperatively from plaque and/or saliva if necessary. The adjacent gingiva was retracted by gingival retraction instruments or matrix bands when necessary to secure unrestricted contamination free access to the field [3]. No bevel was placed. Conditioning of the etch-and-rinse system lesions was performed by applying phosphoric acid or maleic acid followed by thoroughly water spraying for 20 s, carefully air drying in order to maintain a moist dentinal surface following the wet-bonding technique to prevent collapse of unsupported collagen (Table 1). Applying of adhesives and/or light curing was performed according to the manufacturers instructions (Table 1). The resin composite materials were applied in at least two increments using a selected resin composite instrument (Hu Friedy). The resin-modified glass ionomer was applied in bulk and contoured with a slightly wet cotton pellet. Each increment was light cured for 40 s with a light unit, which was controlled for good light intensity once a week (Luxor, ICI, Macclesfield, UK; 400 mW/cm^2).

The restorations were evaluated at baseline, 6, 12, 18, and 24 months and then at least every year during 13 years with regard to retention, marginal adaptation, color match, marginal discoloration, secondary caries and surface roughness. Slightly modified USPHS criteria were used [10]. The clinical bonding effectiveness was determined by the percentage of lost restorations during the evaluation period. In this study only the retention data, which are relevant for the long-term evaluation of the bond are given. The Statistical Package for Social Sciences, Version 14.0 (SPSS, Chicago, USA) was used to process the data. Descriptive statistics were used to present the results. Cumulative retention failures were calculated by dividing the number of lost restorations at the recalls by the total number evaluated. Differences in distribution of the ratings between the adhesive systems for the investigated variables were statistically analyzed by the binomial test for independent samples [11].

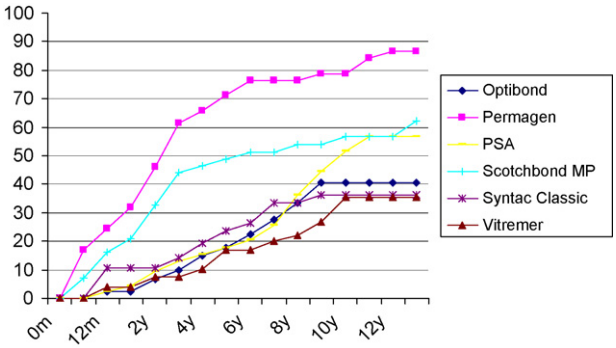

Fig. 1 – Cumulative loss rates (%) of the bonding systems tested in Class V non-carious lesions during the 13-year follow-up.

3. Results

During the 13 years, 20 patients with 55 restorations (Optibond 12, Permagen 3, Scotchbond Multi-Purpose 6, Syntac classic 14, PSA 16, Vitremer 4) could not be evaluated at all recalls due to moving of the patients (22), death (27) or prosthetic or periodontal reasons (6). At the end of the follow-up, 215 restorations could be evaluated. A cumulative number of 114 restorations (50.3%) was lost during the 13 years. For the etch-and-rinse systems Optibond 40.6%, Permagen 86.8%, Scotchbond Multi-Purpose 62.4%, Syntac classic 36.4%, the one-step self-etch system PSA 56.6% and the resin-modified glass ionomer cement Vitremer 35.6%. The annual failure rates for the etch-and-rinse systems were Optibond 3.1%, Permagen 13.0%, Scotchbond MP 4.8%, Syntac classic 2.8%, for the self-etch system PSA 4.4%, and the resin-modified glass ionomer cement Vitremer 2.7%. Significant differences in loss rates were observed between the systems ($p<0.05$). The following ranking was found between the clinical effectiveness of the systems with the best material mentioned first: Syntac classic, Optibond, Vitremer > Scotchbond MP, PSA > Permagen. The cumulative loss rates at the recall periods during the follow-up of the different restorative systems are shown in Fig. 1. None of the restorations was replaced because of recurrent caries, post-operative sensitivity or esthetic reasons.

4. Discussion

Adhesion technology progressed rapidly during the last decennium showing improved bond strength in vitro [1,12]. Most of these bond strength tests are performed directly after establishment of the bond. The biomaterial–tooth interfaces despite good initial bond strength are subjected to mechanical as well as chemical degradation. In the oral envi-