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Clinical evaluation of different adhesive systems for restoring teeth with erosion lesions

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Abstract This investigation evaluated the performance of a resin-modified glass ionomer, a compomer, and a bonding system/composite combination for the restoration of cervical erosion lesions without cavity preparation. Forty-eight lesions (11 patients) were restored with a bonding agent/composite combination [Prime & Bond 2.1/PrismaTPH (P & B/TPH); DeTrey/Dentsply], a compomer (Dyract; DeTrey/Dentsply), or a light-curing glass ionomer (Fuji II LC; Fuji). The materials were randomly assigned to the patients in triplets. No cavity preparation was performed. The procedures strictly followed the manufacturers' instructions. The restorations were evaluated clinically, using modified USPHS criteria, and by quantitative scanning electron microscope (SEM) analysis, at baseline and 12 months. The clinical data were statistically evaluated with the Pearson chi-square test, the SEM data (criterion gap formation) were analyzed with the Mann-Whitney U-test and error rates method. Clinically, two restorations could not be evaluated. One Dyract restoration failed. With respect to marginal discoloration, recurrent caries and contour, no significant differences could be found between the materials. The surface texture of P & B/TPH and Dyract was significantly better than that of Fuji II LC at baseline and 12 months. Compared to P & B/TPH and Fuji II LC, Dyract revealed a significant decrease in marginal integrity between baseline and 12 months. In SEM analysis, gap formation was determined as follows: baseline, enamel interface: 4% Dyract= 4% Fuji >2% P & B/TPH and dentin interface: 11% Dyract >9% P & B/TPH >2% Fuji; 12 months, enamel interface: 15% Dyract >4% Fuji >3% P & B/TPH and dentin interface: 11% P & B/TPH >6% Fuji >5% Dyract. The error rates method revealed no significant differences, in general, between the three materials with regard to gap formation. In conclusion, the restorations of erosion lesions with different classes of adhesive materials were well retained after 12 months. None of the materials studied revealed superiority over the other materials. All materials revealed shortcomings with respect to either surface texture, marginal integrity or color stability clinically and for all materials gap formation was recorded in the SEM evaluation.

Key words Cervical erosion lesion · Compomer · Composite · Glass ionomer · Clinical evaluation

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Introduction

Restorations in the cervical region are subjected to different stresses such as bending forces from occlusal loading and thermal changes in the oral environment. The dentin substrate in the cervical region may vary due to different degrees of sclerotic changes [6]. Thus, the restoration of cervical lesions requires specific attention and careful selection of restorative materials and procedures [3, 18]. Among cervical lesions, cervical erosion lesions demand special consideration. They may require restorative procedures due to esthetic reasons, to prevent pulp damage or because of thermal hypersensitivity. Conventional restoration of non-carious erosion lesions calls for the removal of sound tooth tissue. This is claimed to be avoided when adhesive restorative materials and techniques are used.

Three groups of materials are available and have been successfully used for the adhesive restoration of class V restorations: light-curing, resin-modified glass ionomers, compomers, and composites in combination with bonding systems [1, 18, 27]. Resin-modified glass ionomers combine the advantages of conventional glass ionomers, such as chemical bond to the tooth structure and fluoride release, with the advantages offered by composite technology, such as light-curing and improved mechanical characteristics. The acid–base setting reaction of the glass ionomer is supplemented by a light-initiated resin polymerization. The

adhesion to dentin is improved due to the chemical bond from the polyacrylic acid component on the one hand and the formation of a hybrid layer from the hydrophilic HEMA component on the other. Resin-modified glass ionomers are still susceptible to desiccation. They show wear resistance which is inferior to that of composite or compomers [1, 22] and, due to the relatively large filler particle size, their surface texture is comparatively rough [13, 18, 21, 26].

Compomers are light-curing, fluoride-releasing, one-component materials very similar to composites. They contain acid-decomposable glass and acidic polymerizable monomers with acidic carboxylate groups and polymerizable methacrylate groups, enabling a free radical polymerization by light curing and an acid–base reaction in the presence of water. Compomers are easy to handle and their esthetic properties and some compomers' wear characteristics resemble those of composites [13, 18, 26]. Cariostatic properties due to fluoride release have not been clearly documented [4].

Composite restorations are appreciated for their esthetic qualities, relative wear resistance, and smooth surface texture. However, composite restorations are technique sensitive and the placement of such fillings is time consuming. In cervical lesions which involve enamel and dentin margins, the polymerization shrinkage of the composite resin may result in gap formation at the dentin margin. The adhesive bond strength to enamel exceeds the bond strength to dentin and the restoration fails at the dentin margin. The consequent use of dentin bonding systems and the application of an "all-etch technique" has resulted in an improvement of marginal adaptation along the dentin restoration interface but does not completely prevent gap formation [8, 10, 16].

The present investigation evaluated the clinical performance of a resin-modified glass ionomer, a compomer, and a bonding system/composite combination for the restoration of cervical erosion lesions without retentive cavity preparation by means of modified USPHS criteria and quantitative scanning electron microscope (SEM) analysis. In contrast to similar investigations [10, 19], SEM analysis was included for the evaluation of the restoration margins because using modified USPHS criteria results in a rather coarse evaluation. SEM evaluation allows for detailed recording of gap formation along the margins and thus supplements the findings of the clinical investigation. The overall clinical performance may be predicted more accurately [11, 17].

Materials and methods

Eleven patients, five male and six female, ages ranging from 30 to 77 years, with good oral hygiene and sound periodontal conditions participated in the study. Forty-eight v-shaped, non-carious abrasion/erosion lesions with the margins in the enamel and the dentin were restored with a bonding agent/composite combination [Prime & Bond 2.1/Prisma TPH (P & B/TPH); DeTrey/Dentsply, Germany], a compomer (Dyract; DeTrey), or a light-curing, resin-modified glass ionomer (Fuji II LC; GC, Japan). The materials were randomly assigned to the teeth (n=16 teeth/group), each patient receiving at least one triplet of the restorative materials. The teeth were restored with the materials, strictly following the manufacturers' instructions. The ratio of enamel margin/dentin margin was approximately 30%/70% with respect to the marginal circumference. No retentive cavity preparation with undercuts or bevels in the enamel was performed; the teeth were merely cleaned with pumice slurry on a rubber cup in a low speed handpiece, thoroughly rinsed with water spray, and dried with oil-free air prior to the restoration procedures.

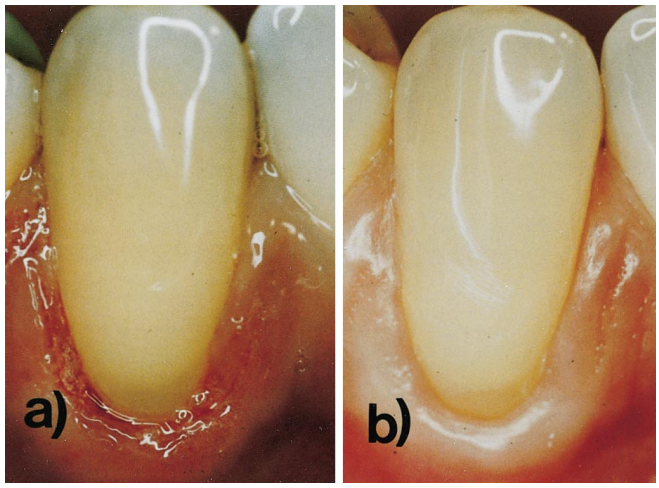

Fig. 1 Clinical aspect of Prime & Bond 2.1/Prisma TPH restoration at baseline (**a**) and after 12 months (**b**)

Clinical procedures

The operative procedures are summarized in Table 1. The manufacturers' directions were closely followed with regard to cavity treatment and placement of the restorative materials. They were placed in bulk once the cavity had been conditioned according to the restorative procedure. Transparent cervical matrices (Hawe Transparent Set; Hawe Neos Mental, Switzerland) were used to reestablish the anatomical shape. Following the curing procedures, excess material was removed and the restorations were finished with fine diamond finishing burs with sufficient water cooling. The restorations were polished with flexible polishing discs (Soflex Pop-on discs; 3 M Healthcare Division, USA). With respect to the light-curing glass ionomer, no surface protection was used as is suggested for conventional glass ionomers. Color slides of the restorations were taken at baseline and at the recalls.

Clinical investigation

Immediately after polishing of the restoration (baseline), and after 6 months and 12 months the restorations were examined clinically (Fig. 1), using an explorer. The clinical condition of the restorations was rated according to the modified USPHS criteria [24] (Table 2). The evaluation was performed by two clinicians who had not been involved in the clinical procedures. If the two ratings were not unanimous, the worse rating was considered for the evaluation of the data. The results of the baseline and 12 month evaluation are reported.

Quantitative SEM evaluation

At all evaluation periods (baseline, 6 months, 12 months), the restored teeth were cleaned with a cotton pellet and chlorhexidine so-

Table 1 Materials and methods

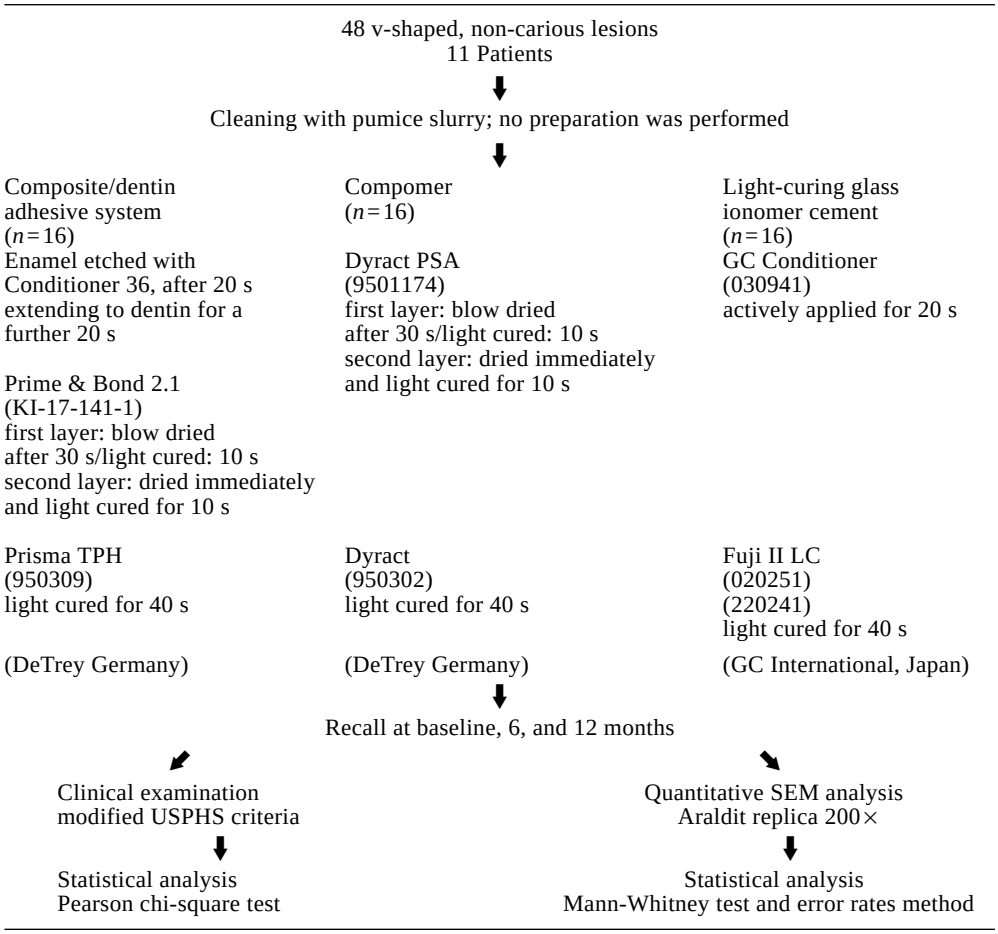

Table 2 Modified USPHS criteria used for clinical evaluation

Criterion	Rating	Operational explanation
Color match	Alfa	Restoration matches shade and translucency of adjacent tooth tissue
	Bravo	Color mismatch between restoration and adjacent tooth tissue but within normal range of tooth shades
	Charlie	Color mismatch between restoration and adjacent tooth tissue beyond normal range of tooth shades
	Delta	Restoration has to be replaced
Marginal discoloration	Alfa	No visual evidence of marginal discoloration
	Bravo	Visual evidence of marginal discoloration at the junction of tooth structure and restoration; discoloration has not penetrated in pulpal direction
	Charlie	Visual evidence of marginal discoloration at the junction of tooth structure and restoration; discoloration has penetrated in pulpal direction along the restoration
	Delta	Restoration has to be replaced
Marginal integrity	Alfa	Explorer does not catch at the tooth/restoration interface
	Bravo	Explorer catches at the tooth/restoration interface; no visible evidence of a crevice and dentin and/or base not exposed
	Charlie	Visible evidence of a crevice; explorer catches; dentin and/or base exposed
	Delta	Restoration is loose, fractured or lost
Recurrent caries	Alfa	No recurrent caries detectable at restoration margin
	Bravo	Recurrent caries adjacent to restoration
Contour	Alfa	Contour matches tooth morphology
	Bravo	Visible erosion/abrasion of filling material
	Charlie	Loss of contour due to wear of filling material, restoration has to be replaced
Surface texture	Alfa	Surface texture of restoration matches surface texture of tooth structure
	Bravo	Slight mismatch between surface texture of restoration and surface texture of tooth structure
	Charlie	Restoration surface is rough and worn, restoration has to be replaced

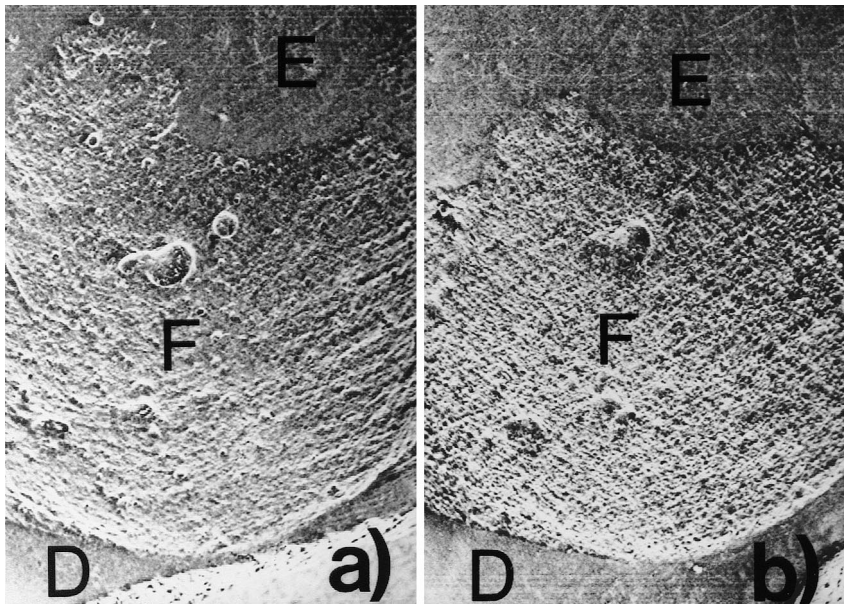

Fig. 2 Fuji II LC restoration in the scanning electron microscope (SEM; 30×) at baseline (**a**) and 12-month recall (**b**). (*E* Enamel, *F* Fuji, *D* Dentin)

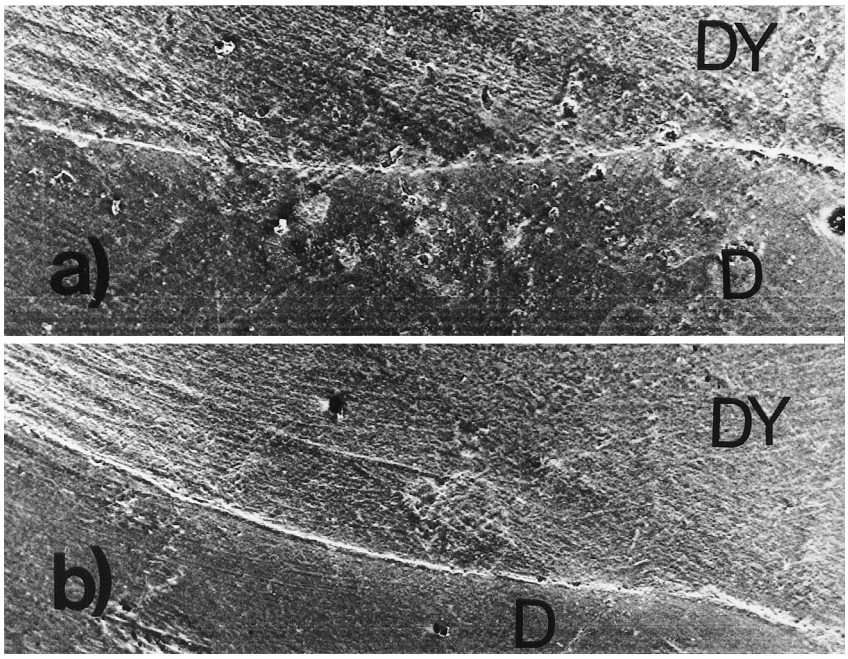

Fig. 3 Dyract restoration in SEM (500×): corresponding margins at baseline (**a**) and 12-month recall (**b**). Dentin/filling interface. (*D* Dentin, *DY* Dyract)

lution, excess moisture was removed by quick blow drying so as not to desiccate the restoration, and impressions were taken (Permagum; ESPE, Germany) for the fabrication of replicas (Araldit; Ciba-Geigy, Germany). Quantitative margin analysis (Figs. 2, 3) was performed on the replicas at 200× magnification in a SEM (Stereoscan 240; Cambridge Instruments, Germany), using an image analyzing system (Videoplan; Kontron, Germany) and following the procedures described by Roulet et al. [23]. Due to technical problems with regard to the evaluation of the lateral parts of the restoration in the SEM, corresponding lengths of the enamel and dentin margins were chosen to perform the SEM analysis (Fig. 4). The enamel–filling interface and the dentin–filling interface were evaluated separately and will be referred to as the enamel or dentin interface. The following criteria were used to describe the margin quality (Fig. 5): Perfect margin: perfect adhesion and adaptation at the enamel–filling interface or at the dentin–filling interface; marginal imperfections: no gap, but marginal imperfection (i.e., excess restorative material, positive or negative ledges) due to the handling of the material; gap formation: a clearly visible loss of adhesion between filling and tooth structure.

The criteria were assigned to the corresponding sections of each interface and calculated as a percentage of the entire length of the interface examined. The results of the baseline and 12-month evaluations are reported, referring to the criterion of gap formation.

Statistical analysis

The clinical data were tested for significant differences using the Pearson chi-square test. The data of the quantitative SEM analysis were tested for significant differences using the Mann-Whitney U-test (SPSS/PC+, vers. 5.01; SPSS, USA). The level of significance,

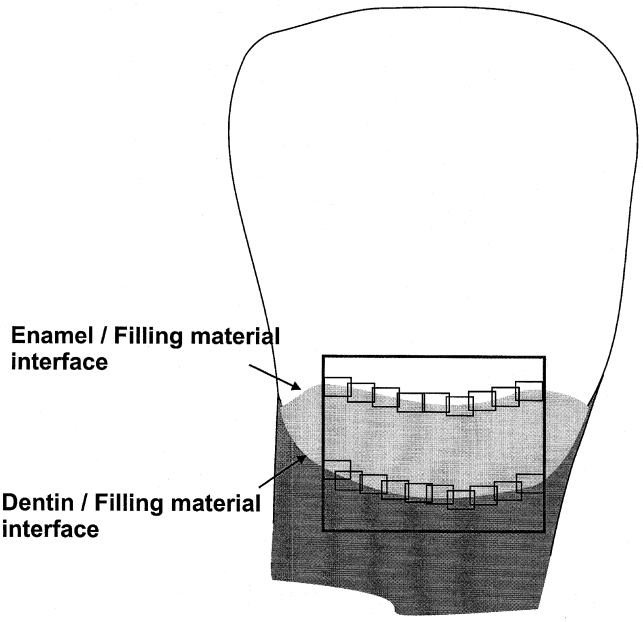

Fig. 4 Determination of corresponding lengths of enamel and dentin for quantitative SEM evaluation

α, was fixed at 0.05. Only pairwise tests may be used in this approach. In order to assess the influence of material, interface, and time on the marginal adaptation, the levels of significance were adjusted to $\alpha^*=1-(1-\alpha)^{1/k}$ (k=number of performed pairwise tests) by application of the error rates method [20].

The statistical analysis was performed with the data obtained from the evaluation of all restoration triplets (n=16 restoration triplets). In a number of patients, more than one triplet had been placed, thus the requirement of independence of the "unit triplet" in these cases was not fulfilled. Therefore, statistics were additionally performed with the triplet/patient as the observation unit on one triplet of restorations randomly selected per patient. In the following, these restorations are referred to as rs (randomly selected) restorations (n=11 restoration triplets).

Results

Clinical evaluation

The results of the clinical examination of all restoration triplets are summarized in Table 3. After 1 year, one Dyract restoration was recorded missing. Two restorations (1 P & B/TPH and 1 Fuji II LC restoration) were lost due to crown preparation of the corresponding teeth. With respect to the criteria marginal discoloration, recurrent caries, and contour, no statistically significant differences could be found between the materials or the recall intervals. The color match of Dyract and Fuji II LC was rated Bravo in 46% (7 out of 15) of the restorations after 1 year, whereas only 3 out of 15 P & B/TPH restorations (20%) revealed a slight color mismatch. The surface texture of P & B/TPH and Dyract was significantly better than that of Fuji II LC at baseline and 12 months: 87% (14 out of 16) of the Fuji II LC restorations were rated Bravo with regard to surface texture at baseline, 100% were rated Bravo at the 12-month recall interval. Dyract revealed a statistically significant decrease in marginal integrity after 12 months, with 40% (6 out of 15) of the restorations rated Bravo compared to 6% (1 out of 16) Bravo ratings at baseline.

In Table 4, the results of the evaluation of the rs restorations (one restoration triplet/patient) are summarized. With respect to marginal integrity, the findings for Dyract were not statistically different between baseline and 12 months. The surface texture of P & B/TPH and Dyract was significantly better than that of Fuji II LC at baseline and 12 months.

Quantitative SEM analysis

The results of the quantitative SEM analysis (n=16 restoration triplets) with respect to the criterion gap formation

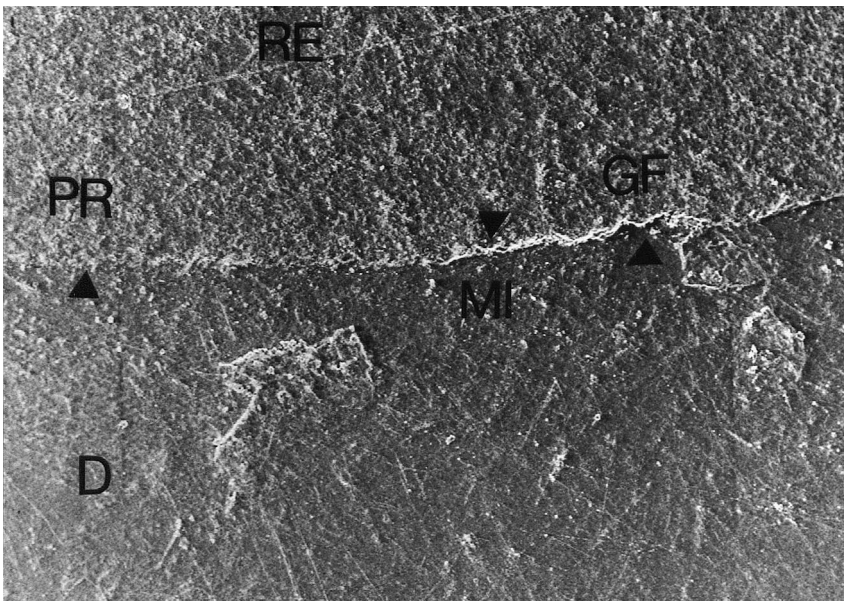

Fig. 5 SEM analysis, criteria. (*RE* Restoration, *D* Dentin, *PR* perfect margin, *MI* marginal imperfections, *GF* gap formation)

Table 3 Clinical ratings of the 16 restoration triplets at baseline (0 months) and after 12 months

	Number of fillings																							
	Prime & Bond 2.1/Prisma TPH								Dyract								Fuji II LC							
Number of fillings in recall/missing	0 months 16/0				12 months 15[a]/0				0 months 16/0				12 months 15/1				0 months 16/0				12 months 15[a]/0			
Score	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Color match	16	0	0	0	12	3	0	0	14	2	0	0	8	7	0	0	11	5	0	0	8	7	0	0
Marginal discoloration	11	0	0	0	13	2	0	0	16	0	0	0	14	1	0	0	16	0	0	0	14	1	0	0
Marginal integrity	14	2	0	0	11	2	0	0	15[b]	1[b]	0	0	9[b]	6[b]	0	0	16	0	0	0	13	2	0	0
Recurrent caries	16	0			15	0			16	0			15	0			16	0			15	0		
Contour	16	0	0		15	0	0		16	0	0		15	0	0		14	2	0		13	2	0	
Surface texture[c]	15	1	0		14	1	0		16	0	0		14	1	0		2	14	0		0	15	0	

[a] One tooth was restored by a crown preparation *alio loco*
[b] Indicates a significant difference in marginal integrity of Dyract restorations at baseline and 12 months
[c] Indicates a significant difference in surface texture between Fuji II LC and Prime & Bond 2.1/TPH and between Fuji II LC and Dyract at baseline and 12 months

Table 4 Clinical ratings of the randomly selected restorations (one restoration triplet per patient) at baseline (0 months) and after 12 months

	Number of patients (total = 11)																							
	Prime & Bond 2.1/Prisma TPH								Dyract								Fuji II LC							
Number of fillings in recall/missing	0 months 11/0				12 months 11/0				0 months 11/0				12 months 10/1				0 months 11/0				12 months 11/0			
Score	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Color match	9	2	0	0	8	3	0	0	9	2	0	0	4	6	0	0	7	4	0	0	7	4	0	0
Marginal discoloration	11	0	0	0	9	2	0	0	11	0	0	0	9	1	0	0	11	0	0	0	10	1	0	0
Marginal integrity	10	1	0	0	8	3	0	0	11	0	0	0	6	4	0	0	11	0	0	0	9	2	0	0
Recurrent caries	11	0			11	0			11	0			10	0			11	0			11	0		
Contour	11	0	0		11	0	0		11	0	0		10	0	0		10	1	0		9	2	0	
Surface texture[a]	10	1	0		10	1	0		11	0	0		9	1	0		2	9	0		0	11	0	

[a] Indicates a significant difference in surface texture between Fuji II LC and Prime & Bond 2.1/TPH and between Fuji II LC and Dyract at baseline and 12 months

are summarized in Fig. 6. At baseline, the enamel interface of Fuji II LC and Dyract revealed 4% gap formation compared to only 2% gap formation at the enamel interface of the P & B/TPH restorations. At the dentin interface, Dyract exhibited the highest loss of marginal adhesion (11%) compared to P & B/TPH (9%) and Fuji II LC (2%). After 1 year, the enamel interface of Dyract revealed 15% gap formation compared to the enamel interface of the Fuji II LC (4% gap formation) and P & B/TPH restorations (3% gap formation). At the dentin interface, P & B/TPH exhibited the highest loss of marginal adhesion (11%) compared to Fuji II LC (6%) and Dyract (5%).

According to the error rates method, no statistically significant differences, in general, were determined between the three materials with regard to gap formation. With respect to the pairwise tests, a significant ($p<0.05$) difference between the enamel and the dentin interface was only recorded for the P & B/TPH combination at baseline. With Dyract, a statistically significant difference ($p<0.05$) was determined between the marginal adaptation to enamel at baseline (4% gap formation), compared to marginal adaptation after 12 months (15% gap formation). At baseline, Fuji II LC revealed significantly ($p<0.05$) better marginal adaptation at the dentin interface than did P & B/TPH and Dyract.

In Fig. 7 the results of the evaluation of the rs restorations (one restoration triplet/patient) are summarized. According to the error rates method, no statistically significant differences, in general, were determined between the three materials with regard to gap formation. With respect to the pairwise tests, Fuji II LC revealed significantly ($p<0.05$) less gap formation at the enamel interface than did Dyract after 12 months.

Discussion

The design of the study itself – the clinical and SEM evaluation of restorations of non-carious cervical erosion le-

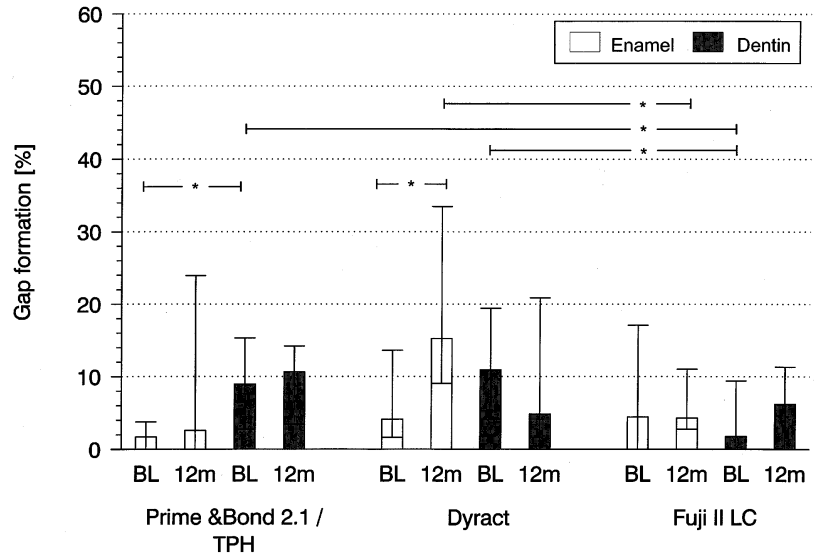

Fig. 6 Quantitative SEM analysis, *n*=16 restoration triplets. Percentage of gap formation at baseline (*BL*) and 12 months (*12 m*) in Prime & Bond 2.1/Prisma TPH, Dyract, and Fuji II LC restorations at the enamel and dentin interface. Medians and 25%/75% quartiles. Statistically significant differences indicated by * ($p<0.05$)

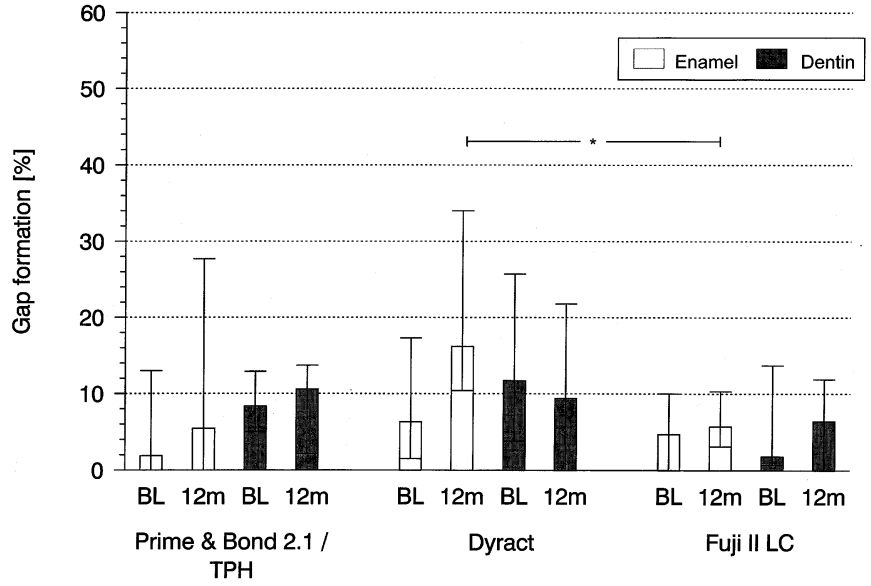

Fig. 7 Quantitative SEM analysis, randomly selected restorations. Percentage of gap formation at baseline (*BL*) and 12 months (*12 m*) in Prime & Bond 2.1/Prisma TPH, Dyract, and Fuji II LC restorations at the enamel and dentin interface. Medians and 25%/75% quartiles. Statistically significant differences indicated by * ($p<0.05$)

sions without any form of cavity preparation – resulted in the very small number of cases (11 patients) and the fact that in some patients more than one triplet of restorations was placed (3×16 restorations). In the literature, clinical evaluations or cumulative retention rates are usually reported [10, 12, 18, 19]. In this study, SEM analysis was included because the clinical ratings only allow for a rather coarse evaluation. Early loss of adhesion or distinct differences between the restorative materials and procedures can only be detected when they become clinically evident, whereas SEM evaluation allows for detailed recording of gap formation along the margins and thus supplements the findings of the clinical investigation [1]. The overall clinical performance may be predicted more accurately [11, 17]. However, the procedures involved to obtain the replicas for SEM evaluation are very technique sensitive and time consuming. In order to establish the procedures, only a small number of patients is currently referred to. It also has to be considered that, in the majority of cases, once a restorative therapy is offered to the patient with a non-carious erosion lesion – even though cavity preparation is not involved – the patient's discomfort is not so afflicting that treatment is taken into consideration.

As in a number of patients more than one restoration triplet had been placed, the required independence of the "unit triplet" was not fulfilled. Thus, additionally, the "unit triplet/patient" was considered by randomly selecting one restoration triplet/patient for the evaluation of the data to comply with the demand that the patient should be regarded as the evaluation unit. The evaluation of the rs restorations is in agreement with the evaluation of all restoration triplets and supplements the finding that, in general, there are no statistically significant differences between the materials.

Clinical evaluation

After 12 months, the different adhesive restorations were well retained. This is in agreement with the results of similar clinical investigations reported by Jedynakiewicz et al. [12] and Loher et al. [18]. The light-curing, resin-modified glass ionomer and the compomer revealed a slight mismatch in color. The best results in terms of color stability can be attributed to the bonding system/composite combination, P & B/TPH. Incomplete polymerization, residual HEMA after light activation, water sorption, and surface characteristics of the set material may be responsible for discoloration [1]. With respect to surface texture, Dyract and the P & B/TPH combination showed a significantly smoother surface than did the light-curing glass ionomer, Fuji II LC. Both the criteria color stability and surface texture must be attributed to differences in the matrix of the materials used as well as to the filler particle size of the inorganic component [18, 26]. In an in vitro investigation, Jung [13] demonstrated that the low surface roughness of a small-particle hybrid composite could be achieved with neither a light-curing glass ionomer nor a compomer.

With respect to marginal integrity, Dyract revealed a significant decrease in marginal integrity after 12 months. With P & B/TPH and Fuji II LC, the restorations showed a better marginal adaptation after 12 months. Changes in marginal integrity may be caused by insufficient finishing and polishing procedures on the one hand [18] and volumetric changes during the setting process of the restoration or due to water uptake and hygroscopic expansion on the other [14, 25]. Whereas Attin et al. [3] reported volume changes in light-curing glass ionomers and Dyract in an in vitro study, Van Dijken [26] recorded no extreme swelling of any of the restoratives used (composite, compomer, and resin-modified glass ionomer) for the restoration of class III cavities. With the use of Dyract, the entire cavity is conditioned with a self-etching primer according to the total-etch technique [8] and the decrease in marginal integrity may also be attributed to the weak bond to enamel [18, 28]. Due to the configuration and geometry of cervical erosion lesions with very low material thicknesses, a higher wear rate could have been expected from the light-curing glass ionomer [18, 21]. However, in the present study, the contour and anatomic form of all three materials remained uninfluenced by wear after 1 year.

Quantitative SEM analysis

According to the error rates method, no statistically significant differences, in general, were determined between the three materials with regard to gap formation. This is in agreement with in vitro and in vivo findings reported in the literature [3, 18, 28].

A significant ($p<0.05$) difference between the enamel and the dentin interface was only recorded for the P & B/TPH combination at baseline, which must be attributed to the cavity configuration on the one hand [5] and the known shortcomings of the dentin–composite bond on the other hand, despite the use of a bonding system and the anticipated establishment of a hybrid layer as an elastic buffer zone [9, 15]. The polymerization contraction in composite resins results in a shrinkage of the material in the direction of the stronger bond, in this case the enamel–composite bond established by acid etching of the enamel [5].

After 1 year, no significant differences could be determined between the three restorative materials with respect to marginal adaptation to enamel and dentin. In general, gap formation was below 15%. This accounts for the fact that, despite the setting stresses certainly developing in Dyract and Fuji II LC due to light initiation of the polymerization [7], the conditioning techniques used in the two restorative techniques can result in the formation of a hybrid layer, as described for the bonding system used prior to the application of the composite [26]. Furthermore, the hybrid layer may act as an elastic buffer zone, compensating for the curing shrinkage which might otherwise result in gap formation or cohesive failure [9, 26].

With Dyract, a statistically significant difference ($p<0.05$) was determined between the marginal adaptation to enamel at baseline (4% gap formation) and the marginal adaptation after 12 months (15% gap formation). The SEM findings are in agreement with the clinical findings, which also indicate a significant decrease in marginal integrity after 12 months. Abdalla et al. [2] reported that restorations of cervical erosion lesions are subjected to continuous loss of tooth structure or the occurrence of small fractures of the materials at the margins, resulting in an increased rate of marginal discrepancies and staining. In an in vitro study, Von Ohle and Reich [28] demonstrated that beveling of the enamel could improve the sealing ability of Dyract; in the present investigation no cavity preparation had been performed and the enamel margins had neither been beveled for the composite nor for the compomer restorations. Both facts may account for the shortcomings recorded with the Dyract restorations.

At baseline, Fuji II LC revealed significantly ($p<0.05$) better marginal adaptation at the dentin interface than did P & B/TPH and Dyract. The reason for this may be that Dyract rather resembles a composite [18] with its rapid development of polymerization shrinkage stresses and the lack of flow capacity once the polymerization process has been initiated. In the light-curing glass ionomer, Fuji II LC, however, the prolonged acid–base reaction may account for a compensation of the setting stresses, thus resulting in the good initial adaptation observed in the present study.

Conclusions

In conclusion, the restorations of erosion lesions with different classes of adhesive materials were well retained after 12 months. None of the materials studied revealed superiority over the other materials. All materials revealed shortcomings with respect to either surface texture, marginal integrity or color stability clinically, and for all materials gap formation was recorded in the SEM evaluation.

However, only an extended observation period will reveal whether these shortcomings recorded after 12 months will be clinically relevant for the longevity of the restoration of erosion lesions without cavity preparation.

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