

# Marginal leakage and consistency of the composite resin material in etched cavities

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The purpose of the study was to evaluate the degree of adaptation of undiluted and diluted composite resin to etched enamel walls with and without an intermediary resin. Cavities ( $\varnothing = 2$  mm) were drilled in extracted teeth and the walls were etched with phosphoric acid. Fillings were made of Concise® composite resin, without applying an intermediary resin (1), after applying the resin layer (2), after diluting the mix with one (3) or two (4) drops of catalyst resin but without an intermediary resin, and after diluting the mix and applying the resin layer (5). The fillings were ground flush with the tooth surface and the teeth were cycled thermally between two dye solution baths. The marginal penetration of the dye was evaluated by measuring the discoloured portion of the margin at different depths using a stereomicroscope. The restorations with an intermediary resin (2 and 5) exhibited significantly less leakage than fillings without the intermediary layer (1, 3 and 4). When no resin layer was applied the dilution of the mix seemed to reduce the leakage compared with undiluted material but the differences were not statistically significant. The results indicate the advantage of using an intermediary resin with etching even when the composite is diluted.

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Improvement of the marginal seal of composite restorations by etching the enamel is well established (11) and the use of an intermediary resin of low viscosity for obtaining optimal results has been recommended (1, 3, 5, 6, 8). The necessity of the intermediary resin has, however, been questioned in some papers (2, 9, 10). When using a syringe for applying the composite, dilution of the pastes with the corresponding catalyst resin makes the material flow better through the syringe tip and prolongs the

working time whereas the universal resin shortens the working time (7). The more fluid material should adhere better to the etched enamel than the pure paste mix and the need for an intermediary resin might thus be eliminated.

The purpose of the present study was to determine the effect of the enamel bond resin on the marginal seal when the resin was used as a lining and when it was used for diluting the composite pastes.

## MATERIALS AND METHODS

Circular cavities were prepared into the buccal and lingual surfaces of non-dehydrated human premolars using a carbide fissure bur ( $\varnothing = 1,5$  mm) with ultrahigh-speed and waterspray. The cavities were extended into the dentin and were not widened on purpose; thus the final diameter of the cavities was approximately 2 mm. The rinsed and dried cavities were etched for 2 minutes with the Concise Etching Liquid® (3M Company, USA). After subsequent rinsing and drying, the cavities were filled with Concise® composite resin (batch no. 513422, 3M Company, USA) with the following variables: 1. without enamel bond resin, 2. after first lining the cavities with the corresponding enamel bond resin, 3. after diluting the pastes with one drop of catalyst resin (7) but without lining the cavities, 4. after diluting the pastes with two drops of catalyst resin but without lining the cavities, and 5. after diluting the pastes with one drop of catalyst resin and lining the cavities with the intermediary enamel bond resin. The composite material was inserted into the cavity immediately after applying the resin layer.

The composite brand Concise was chosen for the present study, because of the two brands (Concise® and Adaptic®) which offer the possibility of using a corresponding unfilled resin to enhance the adhesion to etched enamel, the marginal seal of Concise was shown to be more dependent on the intermediary resin than that of the other brand (5, 6).

The material was allowed to harden before the filling was ground flush with the tooth surface by hand against a 250 grit grinding paper. All excesses extending over the cavity margins were carefully removed. The filled teeth were cycled 200 times between dye solution baths (Nigrosin Fluka 0.5% + sodium-dodecyl-sulphate 1% + H<sub>2</sub>O) at + 6° and +35 °C. The immersion time in each bath was 1 minute. After the thermal cycling the teeth were stored in the solution for one day at +6 °C and for three days at room temperature.

The degree of marginal leakage was determined using a modification of a method described earlier (6). The teeth were allowed to dry in air and the discoloured surface layer of the fillings was ground off against 250 grit grinding paper. A depression 0.2 mm deep was drilled with a round bur in the middle of each filling. This depression was used as a guide during the subsequent removing of three layers. Thus the thickness of each removed layer was less than 0.1 mm. After each removal the length of the discoloured portion of the margin was measured with a scale divided into 36 parts (grades) which was reflected through a stereomicroscope on the filling.

A mean grade of penetration was calculated for each of the five different experimental procedures based on the registrations from 15–17 fillings in each case at three different depths. The mean grades were compared with each other using the Student's t-test.

## RESULTS

The difference in marginal penetration around restorations placed in cavities lined with the intermediary resin and unlined restorations was statistically significant. The present results also indicate that dilution of the composite pastes may reduce the penetration, but not on a statistically significant level (Fig. 1).

## DISCUSSION

The results of this *in vitro* study cannot be directly applied to the clinical situation. In the oral cavity the fillings are exposed to a much greater number of thermal changes which, however, are of shorter duration than in this study. The purpose was only to evaluate the effect of some factors on the adaption and bonding of the filling material to the etched cavity walls. The thermal cycling was done to cause stress on the bonding in order to demonstrate any differences in the various groups.

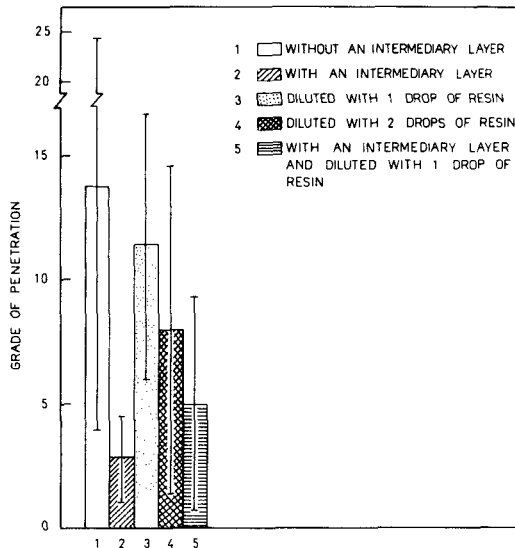


Fig. 1. Mean grades and s.d. ( $n = 15-17$ ) of marginal dye penetration of composite fillings made in 5 different ways (2 versus 1 and 3:  $p < 0.001$ , 2 versus 4 and 5 versus 3:  $0.005 > p > 0.001$ ).

Although it is the intention to leave small excesses of material extending over the margin to secure the seal in clinical work, these may be removed involuntarily during the finishing procedure. Therefore it was thought important in this and the previous studies (5, 6) to use a method where the adhesion to the cavity wall per se was studied. The effectiveness of such a bond was demonstrated in the present series of studies, contrary to earlier findings (e.g. 4). Furthermore one difficult variable was excluded in this way and it made the assessment of the results easier.

Although the limitations of this study have to be considered, the large difference in marginal penetration between fillings with and without an intermediary resin layer confirms earlier results (1, 3, 5, 8) and justifies the recommendation that the cavity should be lined with enamel bond resin before filling it in order to obtain optimal bonding and marginal seal.

## REFERENCES

- Buonocore, M.G., Sheykhleslam, Z. & Glana, R. Evaluation of an enamel adhesive to prevent marginal leakage. An *in vitro* study. *J. Dent. Child.* 1973, 40, 119-124
- Castagnola, L., Wirz, J. & Garberoglio, R. Die Schmelzätzung für die konservierende Zahnbehandlung. *Schweiz. Monatsschr. Zahnheilkd.* 1975, 85, 975-1011
- Dogon, I.L. Studies demonstrating the need for an intermediary resin of low viscosity for the acid etch technique. *Proc. Int. Symp. Acid Etch Tech.* North Central Publishing Co., St. Paul, Minn. U.S.A. 1975, 100-118 pp
- Eriksen, H.M. & Buonocore, M.G. Marginal leakage with different composite restorative materials: effect on restorative techniques. *J. Am. Dent. Assoc.* 1976, 93, 1143-1148
- Forsten, L. Effect of acid etch and an intermediary resin on the microleakage of composites. Paper presented at «The acid etch technique» Symposium, St. Moritz, Switzerland, 1974
- Forsten, L. Effect of acid etching on the marginal seal of composites. *Proc. Int. Symp. Amalgam and Tooth-coloured restorative materials*, Univ. of Nijmegen, Netherlands, 1975, 157-171 pp
- Forsten, L. Working time and strength in relation to consistency of composite resins. *Scand. J. Dent. Res.* 1977, 85, 00-00
- Frei, H.P. Dichtigkeitsprüfungen an Kompositfüllungen mit und ohne Schmelzätzung. *Schweiz. Monatsschr. Zahnheilkd.* 1975, 85, 1012-1029
- Jørgensen, K.D. & Shimokobe, H. Adaption of resinous restorative materials to acid etched enamel surfaces. *Scand. J. Dent. Res.* 1975, 83, 31-36
- Ortiz, R.F., Phillips, R.W., Swartz, M.L. & Osborne, J.W. Effect of composite bond agent on microleakage and bond strength. *J. Dent. Res.*, special issue B, abstract No. 307. 1976
- Roulet, J.F. & Reng, R. Das Problem des Randschlusses bei Kunststofffüllungen. *Schweiz. Monatsschr. Zahnheilkd.* 1975, 85, 1039-1053