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The effectiveness of a primer (contact resin) in diminishing marginal leakage of a direct filling resin (isopast)

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SUMMARY

A recently introduced primer is offered as a means of improving the attachment of a direct filling resin to acid-etched enamel. The effectiveness of the primer in the diminution of the marginal leakage of the resin was investigated. In each of 4 anaesthetized young adult vervet monkeys, 12 labial cavities were cut, one in each of the maxillary and mandibular canine and incisor teeth. Each cavity was cut with a bevelled margin, which was acid-etched. The cavities in the maxillary right and mandibular left teeth were coated with the primer. The cavities were all filled with the resin. The fillings were carefully trimmed and polished. After 56 days the animals were killed and the teeth recovered. Four specimens were lost in recovery. The teeth were varnished, leaving the fillings' margins uncovered, and immersed in a fluorescent dye at 37 °C for 7 days. The specimens were then embedded in clear resin and sectioned. Both surfaces of each specimen were examined by ultra-violet microscopy. Thus 176 points were examined. The results are considered to justify the conclusion that the primer reduced leakage.

OPSOMMING

'n Onlangs vrygestelde tussenhars word aangebied as 'n middel om die hegting van 'n direkte herstellingshars aan suur-geëtste glasuur te verbeter. Die doeltreffendheid van die tussenhars om randlekkasie om harsherstellings te verminder is ondersoek. Vier jong volgroeide blouape is in die ondersoek gebruik. Twaalf kawiteite is in die labiale vlakke van die maksillêre en mandibulêre sny- en slagtande van elke aap voorberei. Die kawiteitsrande is afgeskuins en later met suur geëts. Die tussenhars is net by kawiteite in die regter maksillêre en linker mandibulêre tande aangewend, voor herstelling met die herstellingshars. Die herstellings is daarna versigtig afgewerk en gepoleer. Die ape is 56 dae later om die lewe gebring en al die behandelde tande behalwe vier is herwin. Die tande is sodanig met 'n vernislaag bedek dat net die herstellings en die aanliggende glasuurrande onbedek gelaat is. Die tande is daarna in 'n fluoresserende kleurstof by 37 °C gedompel en vir 7 dae daarin gelaat. Die monsters is daarna in 'n helder akrielhars ingebed en in seksies gesny. Beide vlakke van elke snit is deur middel van ultra-violet mikroskopie ondersoek, sodat altesaam 176 areas ondersoek is. Die resultate toon dat die aanwending van 'n intermidiêre hars op geëtste kawiteitsrande, voor plasing van die herstellingshars, lekkasie om harsherstellings verminder.

INTRODUCTION

The search for a really effective and reliable adhesive dental filling material has not yet attained its goal. The concept of an adhesive filling has two principal attractions. These are improved retention and improved marginal sealing. In attempts to secure better attachment to enamel, various approaches have been employed, notably acid-etching of enamel and the use of an intermediate or primer resin. As far back as 1955 Buonocore reported that the attachment of acrylic filling resin to enamel could be bettered by acid-etching and the technique was later found to be effective with other resins. Over the years, there has been debate concerning the design of the cavo-surface angle. In 1971 Kopel drew attention to the need for research in this area. Speiser and Kahn (1977) found that acid-etching of butt joint enamel margins without an intermediate resin increased marginal leakage. Resins bonded to the axial surfaces of enamel prisms may, by polymerization contraction, produce cracks in the enamel near the margins (Jørgensen, Asmussen and Shimokobe, 1975) and the authors doubt "whether further studies on bonding resin restorations to the axial surfaces of the enamel rods are motivated". Barnes (1977) observed enamel cracks which were unrelated to polymerization contraction. In his study the enamel margins were bevelled, increasing the area of etched enamel available for attachment of resin and making it possible to etch prisms cut more or less transversely. The clinical significance of reported enamel cracks is not clear.

In discussion of the attachment of resins to acid-etched

enamel the viscosity and the fillers of resins have been considered. Pahlavan, Dennison and Charbeneau (1976) concluded that "there were no significant differences between materials with different viscosities, in terms of tag lengths observed". On the other hand, Castagnola, Wirz and Garberoglio (1975) consider that both the viscosity and the size of filler particles in a resin are of importance in determining the depth of penetration of the resin into an acid-etched enamel surface. There may, therefore, be an advantage in marginal leakage control to be derived from the coating of acid-etched enamel with an unfilled primer resin. Ortiz *et al*(1979) examined the effect on the leakage of three filled resins of intermediate resins intended for use with them. Without acid-etching the primers (or bonding agents) did not enhance the marginal seal. In cases where acid-etching was employed, there was little difference whether the primers were used or not. Butt joints were used.

The possibilities of bonding to calcified tooth tissues by a surface-active comonomer were discussed by Bowen (1965). Chandler *et al*(1974) investigated the clinical effectiveness of a surface-active comonomer (NPG-GMA recrystallized from acetone). They concluded that the comonomer was clinically effective in improving the margins of composite restorations. In a laboratory study Retief (1975) found that an NPG-GMA adduct was not very effective in promoting the attachment of resin to enamel.

From the foregoing it will be seen that the attachment and, hence, the marginal seal, of resinous filling materials is improved by acid-etching. There is doubt about the value of the butt joint in relation to acid-etching. Priming with a surface-active comonomer is also of doubtful value and the value of the priming of enamel margins with an unfilled resin is debatable.

In this investigation an attempt was made to compare the effect on marginal leakage *in vivo* of filling cavities having bevelled cavo-surface angles with a direct filling resin (without an inorganic filler) used in conjunction with a primer and without the primer.

MATERIALS AND METHODS

The materials are identified in Table I. The direct filling resin, ISOPAST, has no inorganic filler and may, therefore, be mixed with a metal spatula on the pad supplied with the material. The primer resin, CONTACT RESIN, is supplied as a powder in doses in metal foil cups. The liquid is added to the powder from a dropper bottle and mixed in the foil cup with a small disposable brush, which is subsequently employed for painting the primer resin onto the cavity margins.

Four young adult vervet monkeys (*Cercopithecus aethiops*) with intact anterior teeth were selected and, after immobilization with intramuscular ketamine hydrochloride* (5 mg/kg), were anaesthetized with intravenous pentobarbitone sodium**. A labial cavity was cut in each of the 12 maxillary and mandibular canine and incisor teeth, using a plain cut inverted cone bur, size ISO 010 (U.S. 35) in an air turbine handpiece with water spray. The cavity margins were bevelled, using a conical fine-grain carborundum stone in a low-speed handpiece with water spray. The cavities were flushed with an air/water spray before drying with compressed air and the margins were etched with an acid preparation, EMAIL-PREPARATOR***, for 1 minute. The cavity toilet was repeated and the dried cavity margins were painted with the primer in the maxillary right and mandibular left teeth. The cavities were then filled with the direct filling resin. The hardened fillings were carefully trimmed with flexible abrasive disks to reproduce normal morphologic contours, finishing with fine-grain disks. The fillings were then polished with synthetic rubber polishers**** intended for use with the direct filling resin. The trimming and polishing were carried out with a low-speed handpiece, using a copious water spray to prevent overheating of the resins and cavity margins.

After 56 days the animals were killed with a lethal dose of anaesthetic and the specimens were recovered. Four teeth were lost in recovery: thus 44 specimen teeth became available for examination. The teeth were coated, when dry, with celluloid (nail) varnish, the varnish being applied so as to leave the fillings and immediately adjacent enamel uncovered. The teeth were immersed for 7 days (168 hrs) in fluorescent dye*****, as used by Holliger (1967) at 37 °C. Subsequently the varnish was removed from the crowns with scalers. The specimens were then embedded in a clear resin and sectioned transversely through the fillings. The sections were approximately 1,2 mm thick.

The sections were examined on both sides. Thus a total of 176 points (sectioned cavity margins) were examined, 88 points were on margins treated with the primer, the other 88 on margins to which the primer had not been applied. Each section was laid on a microscope slide, examined, then inverted and re-examined. Examination was undertaken with transmitted ultraviolet radiation, using a Univar****** optical microscope. Leakage was graded as follows:-

Table I Identification of materials

Brand	Type	Manufacturer	Batch Number
ISOPAST	Direct filling resin Two pastes in syringes	Vivadent Schaan, Liechtenstein.	160 677 (base, shade 30) 280 677 (catalyst)
CONTACT RESIN	Primer resin Powder in foil cups Liquid in dropper bottle	Vivadent, Schaan, Liechtenstein	4712

* Ketalar, Parke-Davis, Cape Town, South Africa.
** Sagatal, Maybaker (S.A.), Port Elizabeth, South Africa.
*** Vivadent, Schaan, Liechtenstein.
**** Vivadent, Schaan, Liechtenstein.
***** Blak-Ray, U.V. Products, Inc., San Gabriel, U.S.A.
****** C. Reichert, A.C., Vienna, Austria.

Class 0 No leakage (Fig 1).
Class I Leakage not beyond the amelo-dentinal junction (Fig 2).
Class II Leakage beyond the amelo-dentinal junction
Class III Leakage to the cavity floor.

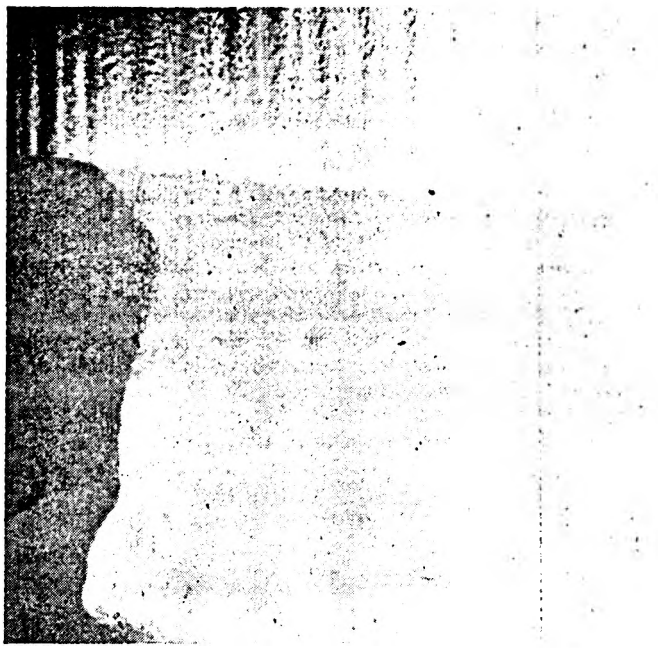


Fig. 1 ISOPAST with CONTACT RESIN. No leakage (Class 0). Top - embedding resin. Left middle - enamel. Left bottom - dentine. Right - filling resin.

DISCUSSION

Under the experimental conditions described there was a definite reduction in the amount of marginal leakage in the cases where the primer was applied to the cavity margins.

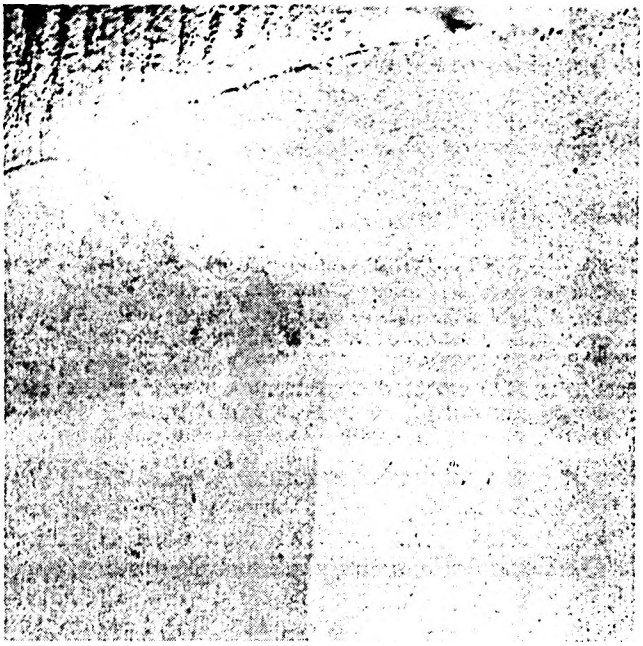


Fig. 2 ISOPAST with CONTACT RESIN. Leakage (Class I). Top - embedding resin. Left middle - enamel. Left bottom - dentine. Right - filling resin.

Table II Leakage of 22 specimens with primer

Points examined	Points showing no leakage Class 0	Points showing leakage Class I	Class II	Class III	Total points showing leakage (of 88)
88	82	6	0	0	6

Table III Leakage of 22 specimens without primer

Points examined	Points showing no leakage Class 0	Points showing leakage Class I	Class II	Class III	Total points showing leakage (of 88)
88	72	12	3	1	16

RESULTS

The results are tabulated in Tables II and III. It will be seen that with the primer more points showed no leakage than without the primer. With the primer there was no leakage beyond the amelodentinal junction. Without the primer, several specimens showed leakage beyond the amelo-dentinal junction.

Application of the Chi-square test to the data revealed that the greater leakage seen when no primer was used was statistically significant at the 5 per cent level (χ^2 = 5,19, degrees of freedom = 1).

Monkeys obviously ingest their food and drink at cage temperature. Hence the effect of temperature variations is disregarded in the methodology of a study such as this. It is felt that too much importance should not be attached to this aspect of such a study, for two reasons. Firstly, in the case of an anterior restorative material, the fillings are protected to some extent by the lips. Secondly, the temperature differentials employed in laboratory thermocycling are sometimes rather extreme.

It is considered reasonable to conclude that the use of the primer CONTACT RESIN in conjunction with the

direct filling resin ISOPAST offers a quite marked advantage in the reduction of marginal leakage.

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