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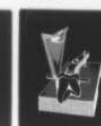
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ABSTRACT (Continue on reverse side if necessary and identify by block number) A study based on the laboratory characterization of four adhesive re- storatives was conducted. The findings indicated that adhesion of three of the materials to the components of tooth structure was unreliable. Strength properties of adhesive systems of the BIS-GMA type were superior to those of a glass ionomer cement. Clinical application of the test materials should be limited to the restoration of conventional Class III and Class V cavities.		

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DENTAL ADHESIVES: A PERSPECTIVE

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DENTAL ADHESIVES: A PERSPECTIVE

During the past decade, several polymeric adhesive restoratives have become available for use in military dental practice. These materials can be applied only to teeth that have been pretreated or conditioned with certain acids. Such treatment removes surface debris, increases surface wettability and etches the substrate. Etching produces an increased surface area and opens pores into which a restorative material can flow. Adhesion results from micromechanical interlocking of the restorative at the tooth-restoration phase boundary.

Numerous inquiries concerning the applicability of certain proprietary adhesive systems to military dental practice promoted initiation of the present investigation.

Materials and Methods

Test materials included three chemically polymerized composite restoratives of the BIS-GMA type (Adaptic,^{*} Powderlite⁺ and Cervident⁺) and a glass ionomer cement (ASPA[#]).

* Johnson and Johnson, Dental Products Division, East Windsor, NJ 08520.

+ S. S. White Division, Pennwalt Corp., Philadelphia, PA 19102.

The L. D. Caulk Co., Division of Dentsply International, Inc.,
Milford, DE 19963.

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For the production of test pieces, all components of the restoratives were proportioned and manipulated in accordance with manufacturers' instructions. Specimens were aged in distilled water at 37°C. for 24 hours prior to testing. All mechanical tests were performed on a constant strain-rate testing machine[§] at a crosshead speed of 0.02 inch per minute.

Freshly extracted human molars were used in assessment of enamel-restorative and dentin-restorative bond strength. Enamel-restorative couples were made in the following manner. The teeth were scrubbed with detergent, polished with fine pumice, rinsed with water and air-dried. The facial and lingual surfaces of the coronal portions of the teeth were acid-etched by prescribed technique. After application of recommended coating agents and adhesion promoters, the restoratives were attached to the pretreated enamel surfaces with the use of paper matrices fashioned from 0.5-inch segments of 0.155-inch inside diameter soda straws.

In the preparation of specimens for measurement of dentin-restorative bond strength, enamel was abraded from the facial and lingual surfaces of the test teeth with the use of a belt sander. Cleansing and pretreatment of the exposed dentin as well as application of the restoratives was accomplished as described earlier.

§ Instron Universal Testing Machine, Instron Corp., Canton, MA 02021

Use of the fixture shown in the figure facilitated stabilization and orientation of bond strength-specimens under the guillotine-extension of the testing machine's crosshead. Bond strength was calculated from ultimate load at shear failure per unit area of tooth-restorative contact.

Specimens for determination of compressive strength were 0.25 X 0.50-inch cylinders, the ends of which were planed flat and at right angles to their axes. Tensile strength was measured by diametral compression of 0.25-inch diameter, 0.06-inch thick discs.¹ Modulus of elasticity (rigidity) was estimated from relative platen displacement in compressive tests.²

Results

The experimental data are summarized in the table. Reported property values are based on a minimum of six observations.

Bond strength data exhibited wide scatter. Generally, however, the restoratives showed greater adhesion to enamel than to dentin.

Compressive and tensile strengths of the glass ionomer cement were significantly lower than those of BIS-GMA based materials. All modulus of elasticity values were of the same order of magnitude. However, Cervident and Powderlite tended to be more rigid than either Adaptic or ASPA.

Discussion

Adhesive materials are often employed in novel restorative procedures. However, the user of these materials must realize that unpredictable biologic, physical and mechanical factors can affect the

characteristics of the restorations he places.

From the data, it would appear that a significant level of adhesion to enamel can be attained with the use of the Adaptic system. The less effective adhesion of the other materials may be a manifestation of high viscosity which restricts their flow into microscopic irregularities. The adhesion of Adaptic to dentin-surfaces, like that of the other test products, is negligible.

The resin-based composites and the glass ionomer cement appear suitable for use in conventional Class III and Class V cavity preparations. Etching of the enamel in the vicinity of the cavo-enamel margin may enhance retention of the restoration and reduce marginal leakage. Use of these materials for the restoration of areas of cervical erosion or for other extraordinary procedures is not warranted unless sufficiently retentive cavity preparations are made.

Summary

↓ A study based on the laboratory characterization of four adhesive restoratives was conducted. The findings indicated that adhesion of three of the materials to the components of tooth structure was unreliable. Strength properties of adhesive systems of the BIS-GMA type were superior to those of a glass ionomer cement.

Clinical application of the test materials should be limited to the restoration of conventional Class III and Class V cavities. ↓

References

1. Civjan, S., and de Simon, L. B.: Evaluation of the Diametral Compression Test. J Dent Res 46:1540, 1967.
2. Taylor, D. F., and Margetis, P. M.: Progress Report on Setting Time for Dental Amalgam, National Bureau of Standards Report No. 6109, 1958.

Legend for Figure

Fixture for stabilization of tooth-adhesive couples.

TABLE

APPARENT PROPERTIES OF ADHESIVE RESTORATIVE MATERIALS

Material	Bond Strength to Enamel (psi)	Bond Strength to Dentin (psi)	Compressive Strength (psi)	Tensile Strength (psi)	Modulus of Elasticity ($\times 10^6$ psi)
Adaptic	3,000 \pm 800	300 \pm 200	38,000 \pm 2,300	5,500 \pm 800	1.06 \pm 0.08
Powderlite	1,500 \pm 1,100	100 \pm 70	44,000 \pm 4,100	6,600 \pm 600	1.70 \pm 0.24
Cervident	1,000 \pm 700	400 \pm 300	42,000 \pm 2,900	6,300 \pm 300	2.04 \pm 0.09
ASPA	500 \pm 300	100 \pm 100	29,000 \pm 4,000	2,200 \pm 300	1.40 \pm 0.22

