OPERATIVE DENTISTRY

AMERICAN ACADEMY OF GOLD FOIL OPERATORS

ACADEMY OF OPERATIVE DENTISTRY

spring 1989 • volume 14 • number 2 • 57-112

(ISSN 0361-7734)

OPERATIVE DENTISTRY

SPRING 1989 • VOLUME 14 • NUMBER 2 • 57-112

Aim and Scope

Operative Dentistry publishes articles that advance the practice of operative dentistry. The scope of the journal includes conservation and restoration of teeth; the scientific foundation of operative dental therapy; dental materials; dental education; and the social, political, and economic aspects of dental practice. Review papers and letters also are published.

Publisher

Operative Dentistry is published four times a year: Winter, Spring, Summer, and Autumn, by:

Operative Dentistry, Inc
University of Washington
School of Dentistry, SM-57
Seattle, WA 98195 USA

POSTMASTER: Send address changes to this address. *Operative Dentistry* is the official journal of the American Academy of Gold Foil Operators and the Academy of Operative Dentistry.

Subscriptions

Yearly subscription in USA and Canada, $45.00; other countries, $55.00 (sent air mail); dental students, $25.00 in USA and Canada; other countries, $34.00; single copy in USA and Canada, $13.00; other countries, $16.00. For back-issue prices, write the journal office for quotations. Make remittances payable (in US dollars only) to *Operative Dentistry* and send to the above address.

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EDITORIAL

Scholarly Activities: Part 2

In the Winter 1988 issue of *Operative Dentistry*, the topic of "scholarly activities" as an increasing requirement for promotion, tenure, and merit raises was addressed. That particular editorial struck a responsive chord from the vast majority of our readers; therefore, it seems appropriate that we pursue the topic of faculty tenure and scholarly activities further. Specifically, what long-range impact will the "publish-or-perish-at-all-costs" syndrome have on clinical restorative dentistry to be taught in dental schools?

Dental schools were established to train individuals to practice the art and science of dentistry. Originally this educational process dealt almost exclusively with predoctoral programs intended to graduate individuals who could practice dentistry in a general-practice setting. We have seen, within the last 25 years, a large increase in the numbers of graduate training programs added to the dental schools' educational endeavors. In many instances, the graduate programs were added at the expense of faculty support for predoctoral students, thereby diluting faculty efforts on their behalf.

Today, as at the start of this century, the primary need for dental service remains that of restorative dentistry, and such treatment still consumes the major portion of a dentist's treatment time. Today the dentist is called upon to provide a much more complicated and sophisticated treatment than we ever would have dreamed about 25 years ago.

The message is that restorative dentistry is as important today as it ever was and will be well into the next century. Needless to say, not everyone agrees. Many dental school faculty feel that "hands-on" clinical dentistry is the least important portion of undergraduate dentists' education. They would have us believe that if the students are taught in dental school how to think, do research, and use their intellect to make decisions, the treatment rendered will be automatically excellent. Also, these same individuals think that restorative dentistry is all but dead and there is no real need for such care as "caries has been eliminated." There is no denying that today's dental students are bright beyond our wildest dreams. But is being academically brilliant all there is to it?

Many of the critics of restorative dentistry feel students should be trained in research methodology and be required to conduct research. These same individuals are those who insist on the "publish-or-perish" syndrome. Of course, both students and faculty must sacrifice valuable clinical training and teaching time to do so.

The drive to compel all faculty members to become researchers and have publishing as their first priority just to attain tenure and promotion is certainly consistent with another trend -- that faculty members in all clinical departments have PhD degrees in a basic science, rather than possessing clinical expertise. As a department chairman I can assure you that if I wanted to hire a faculty person to do basic research, I would look for an individual with a PhD versus a DDS degree. On the other hand, for clinical faculty we need practicing dentists possessing excellent clinical skills as well as current knowledge of the literature and a broad-based didactic background. Only excellent clinicians can equip the students to provide the quality of excellent clinic care patients expect and deserve.

The push for the dentist-scientist program designed to lead faculty to be research-oriented and to possess a PhD degree in a basic science will create faculty members competent in research, with the skills to jump through the hoops for tenure and promotion. But will dedication to the sciences assist them in clinical teaching? I think not!

In just a few years we will be beyond the point of no return. By that I mean our educational system will be so diluted by the basic sciences, coupled with the "publish-or-perish" syndrome, that the graduating dentist of tomorrow will be an excellent scientist but a lousy dentist. Dental schools are rapidly losing their clinical identities. Is this what you want? Can we afford a faculty without recognized clinical excellence? Who will be teaching the complicated and sophisticated treatment required which is and will be expected of our profession?

DAVID J BALES
Editor

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ORIGINAL ARTICLES

A Clinical, Radiographic, and SEM Evaluation of Class 2 Composite Restorations in Primary Teeth

E EIDELMAN • A FUKS • A CHOSACK

Summary

Sixty class 2 composite resin restorations were placed in 22 children and evaluated at baseline, six months, and one year. Radiographs were used for evaluation, in addition to clinical examinations, photographs, and scanning electron micrographs of epoxy resin casts of retrieved teeth. It was concluded that radiographs are necessary to detect a large percentage of failures at the gingival margins of class 2 composites.

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Introduction

Two-year data for composite restorations in primary molars have shown promising results when evaluated clinically. In that study, a restoration was considered a failure when it needed replacement due to fracture, recurrent caries, or because it was missing (Oldenburg, Vann & Dilley, 1985). Previous studies have reported modified cavity preparations with failure rates of up to 34% after two years (Paquette & others, 1983).

Mjör (1985) reported that caries recurred mainly at cervical and approximal margins in class 2 restorations. He also reported that the gingival margin has the highest risk for microleakage and secondary caries, and that it is not amenable to direct clinical examination unless the approximating tooth is missing. It has been reported that incremental placement and polymerization reduces the polymerization shrinkage and consequent microleakage (Jorgensen & Hisamitsu, 1984). A recent study in vitro (Lui & others, 1987) also reported that the incremental method showed less microleakage than the bulk technique; it was also reported that the frequency of excellent margins was significantly lower in the cervical margins than in the other margins of class 2 composite restorations.

This study had two aims:

1. To evaluate clinically and radiographically class 2 composite fillings placed in primary teeth using bulk and incremental filling techniques, and
2. To assess the gingival, buccal, and lingual margin of the approximal box by direct clinical evaluation and scanning electron microscopy (SEM) of retrieved teeth.

Experimental design

Children attending a school dental clinic in a Jerusalem suburb were included. To be eligible, the children had to be 8-12 years of age, have a primary molar with interproximal caries, and occlusal and approximal contacting adjacent teeth, be available for recall appointments every six months until shedding of the teeth, and have parental consent to participate in the study.

Following a history and clinical examination, bite-wing radiographs were taken and a treatment plan developed; teeth were assigned to either bulk or incremental filling by toss of a coin. A total of 60 class 2 cavities in primary molars of 22 children were filled with Herculite (Kerr Mfg Co, Romulus, MI 48174), an ultrasmall particle hybrid restorative material. Three experienced operators participated in the study.

Clinical procedure

All restorations were placed with local anesthesia and a rubber dam. A conventional class 2 cavity preparation was cut utilizing a #330 carbide bur. Exposed dentin at the pulpal walls was protected with Dycal (L D Caulk Co, Milford, DE 19963). The enamel cavity margins were etched with Command etchant gel (Kerr Mfg Co, Romulus, MI 48174) using a fine brush provided by the manufacturers. After 60 seconds the teeth were rinsed with water for 20 seconds, air-dried, and two layers of an enamel-and-dentin-bonding resin (Bondlite, Kerr Mfg Co) were applied to all cavity surfaces and margins. Each layer was followed by a gentle stream of air to evaporate the solvent; light polymerization followed for 20 seconds. A stainless steel "T" matrix band and interproximal wedges were placed. The cavities were filled with condensable composite Herculite using smooth surface amalgam condensers. The first two increments were light-polymerized for 20 seconds each, followed by a 60-second light-exposure for the third increment; the first two increments were filled up to the level of the pulpal wall. For the bulk group, after condensation and contouring of the composite, it was light-polymerized for 60 seconds.

Following wedge and matrix removal, 20 seconds of light exposure was used for the buccal and lingual embrasure in both groups. The restorations were finished with alpine stones and Soflex disks (3M Dental Products Co, St Paul, MN 55144), and following removal of the rubber dam, occlusal contact was adjusted and a clinical picture taken.

The restorations were evaluated at baseline, six months and one year for surface appearance, color match, marginal adaptation, marginal discoloration, anatomic form, and secondary caries using the criteria described by Cvar and Ryge (1971).

Evaluation at baseline and recall examinations were done by at least two of the three examiners in each case, and a consensus reached in case of disagreement.

After completion of the baseline evaluation, the children were encouraged to return exfoliated teeth, or preferably, to return to the clinic when increased tooth mobility was evident. The retrieved teeth were examined with an explorer and evaluated using the same criteria described by Cvar and Ryge (1971). A photograph was taken of the occlusal and approximal surface, a radiograph taken, a silicone impression made of the approximal surface, and an Araldite (Epokwick, Buehler Ltd, Lake Bluff, IL 60044) replica poured, mounted in aluminium stubs, gold-coated, and examined in the SEM. The chi-square test was used for statistical analysis.

Results

From the original 60 restorations, 58 were available for clinical and radiographical assessment after one year. Of these, 27 had been restored by the incremental method, and 31 by the bulk technique. The clinical evaluation of the occlusal surfaces is presented in Table 1. In all the para-

Table 1. Clinical Evaluation of 58 Occlusal Surfaces after One Year

Criteria evaluated	Rating*			
	Alpha	Bravo	Charlie	Delta
Surface appearance	57	1	-	-
Color match	58	-	-	-
Marginal adaptation	53	4	-	1
Marginal discoloration	55	3	-	-
Anatomic form	57	-	-	-
Secondary caries	56	2	1	-

*USPHS system (Cvar & Ryge, 1971)

Table 2. Findings of Radiographic Examination after One Year by Filling Technique

Filling technique	# of cases	Defect at gingival margin
Incremental	27	9
Bulk	31	14
Total	58	23

meters assessed, over 90% were rated Alpha; two teeth were rated Bravo for secondary caries. Because of the high proportion of Alpha ratings in the occlusal surfaces, the results were not presented separately for bulk and incremental filling techniques. Typical examples of the clinical appearance are shown in Figures 1A and 1B. Figures 2A, 2B, 2C and 2D show a clinical photograph and radiograph of an MOD restoration in a second primary molar after one year, and a photograph and a microradiograph of the approximal surface after exfoliation. The radiographic findings in the 58 restorations are presented in Table 2. Radiolucent defects at the gingival margin of the approximal surface were found in 9 out of 27 incremental fillings (33%), and 14 out of 31 bulk restorations (45%). This difference, however, was not statistically significant ($P > 0.05$). No attempt was made to differentiate between inadequate filling, shrinkage, or secondary caries. Examples of the radiographic defects are presented in Figure 3.

Table 3 summarizes the findings of the visual and tactile evaluation of 19 approximal surfaces of the class 2 restorations examined in the retrieved teeth. Surface appearance, marginal adaptation, marginal discoloration, and secondary caries were evaluated. The marginal adaptation and discoloration were assessed separately for the cervical, buccal, and lingual margins. Marked differences were observed between

Table 3. Clinical Evaluations of 19 Approximal Surfaces of Class 2 Restorations in Retrieved Teeth

Criteria evaluated	Rating			
	Alpha	Bravo	Charlie	Delta
Surface appearance	9	5	4	1
Marginal adaptation				
Cervical	5	13	1	-
Buccal	17	1	1	-
Lingual	18	1	-	-
Marginal discoloration				
Cervical	7	11	1	-
Buccal	17	1	1	-
Lingual	16	3	-	-
Secondary caries	17	-	2	-

Table 4. SEM Evaluation of Buccal, Lingual, and Cervical Margins of the Approximal Surfaces in the Retrieved Teeth by Percentage of Defective Margin and Filling Technique*

Margin	Percentage defective by filling technique	
	Incremental	Bulk
Buccal	48	31
Lingual	31	34
Cervical	79	80

*Defective Margin: A distinct crevice is visible between the tooth and the restoration.

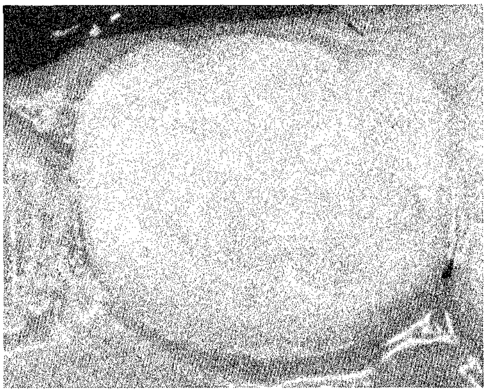


FIG 1A. *Mesio-occlusal restoration in second primary molar rated Alpha for all the parameters after one year*

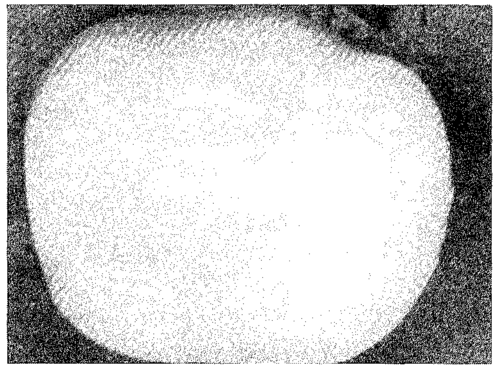


FIG 1B. *Occlusal view of an MOD restoration in a retrieved second primary molar also rated Alpha for the occlusal surface*

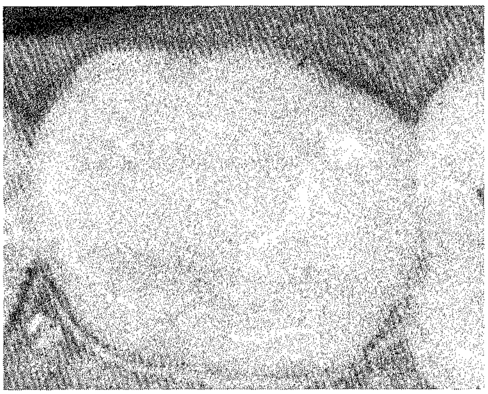


FIG 2A. *Clinical photograph of an MOD restoration in a second primary molar after one year*

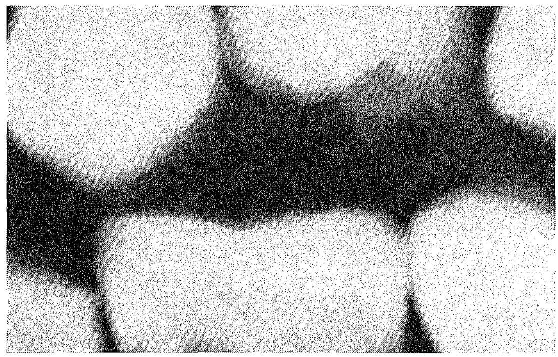


FIG 2B. *Bite-wing radiograph of same tooth prior to exfoliation, showing a radiolucent defect at the gingival margin of the mesial box*

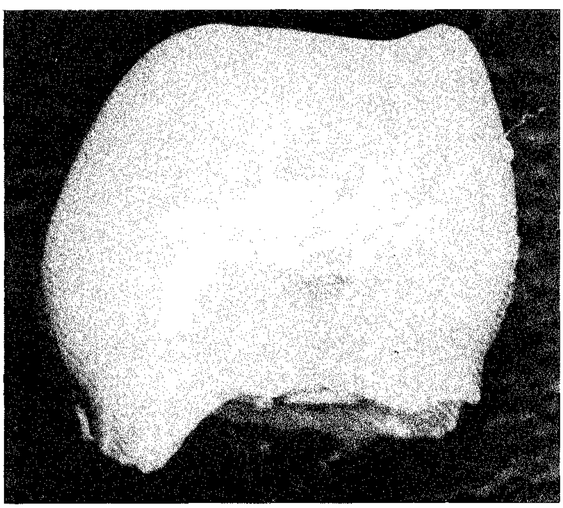


FIG 2C. *Clinical photograph of the mesial surface of the same tooth after exfoliation, showing a large defect along the cervical margin*

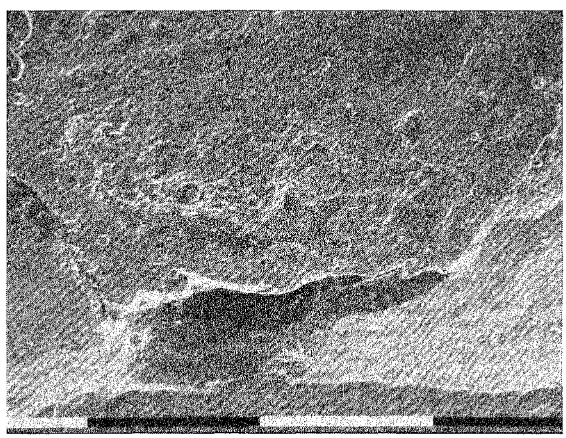


FIG 2D. *Photomicrograph of the same surface showing a large gap at the cervical margin (Bar = 1 mm)* the cervical and the other two margins. Only 26% of the cervical margins were rated Alpha for marginal adaptation, compared to 90% and above of the buccal and lingual margins. Marginal staining was observed in 63% of the cervical margins, compared with 15% or less of the buccal and lingual margins. Only 47% were evaluated as Alpha for surface appearance. Caries was diagnosed in two cases, one at the cervical margin and one at the buccal margin. Photographs of three representative restorations are presented in Figures 4A, 4B, and 4C. Since no statistically significant difference was found between the bulk and incremental filling techniques, the findings were pooled.

The SEM evaluation of buccal, lingual and cervical margins of 17 approximal surfaces by percentage of the length of the margin found to be defective and by the method of filling is presented in Table 4. The cervical margins showed the highest percentage of defective margin. No difference was found between the two filling techniques for the cervical margin (79% vs 80% defective). Figure 5 shows a photomicrograph of margins of the approximal surface which appeared acceptable in Figure 4C, demonstrating a defect in the linguo-cervical angle.

Discussion

The clinical evaluation showed high success rates of the class 2 composite restorations after one year; these findings are in agreement with previous reports (Oldenburg & others, 1985; Paquette & others, 1983). Radiographic examination after one year, however, demonstrated that in 40% of the restorations radiolucent defects could be seen at the gingival margin; as exfoliation of these teeth was anticipated in the near future, no replacement of these restorations was attempted. These radiolucencies could be the expression of a number of factors such as polymerization shrinkage, inadequate adaptation of the material to the gingival wall, difficulty of placement at the approximal box, and shrinkage toward the light source (Lui & others, 1987).

The approximal wall is not amenable to direct clinical examination; when exfoliated teeth were examined, we found that the surface and margin of the approximal areas fell far short of the excellent results of the occlusal area. To our knowledge, only one previous study in vivo assessed visually the approximal surface of class

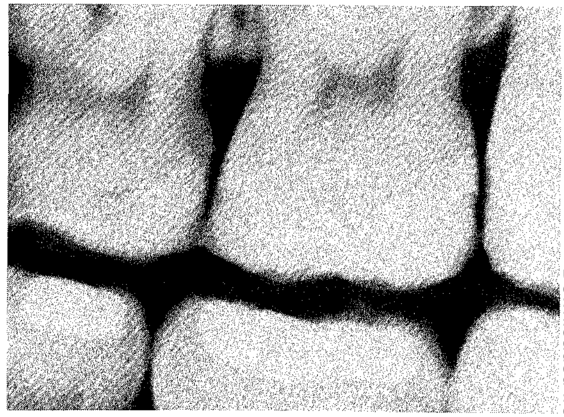
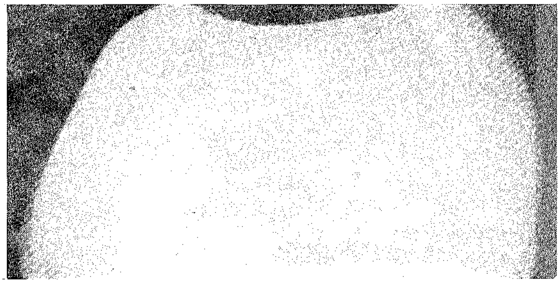


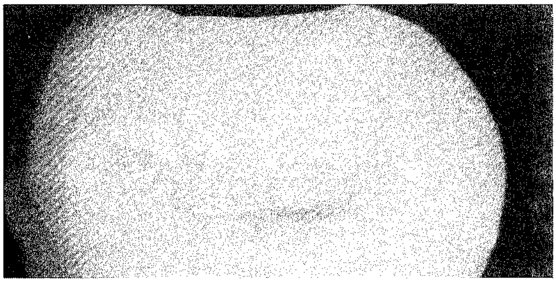
FIG 3. *Bite-wing radiograph showing composite restorations in first (DO) and second (MOD) maxillary primary molars. Notice gaps at all gingival margins and bubbles in the body of the mesial and distal aspects of the restoration in the second primary molar. The radiolucency under the occlusal portion of the first primary molar may be due to pooling of the radiolucent bonding material.*

2 composites (Varpio, 1985). Direct comparison with Varpio's study is difficult because of differences in methodology and materials used; however, she reported that examination of 31 retrieved teeth showed only 10 teeth without defects in the approximal surface as compared to three out of 19 restorations in the present study that were found free of marginal crevice or staining. The follow-up period in our study was only one year, and secondary caries was found only in two of the retrieved teeth.The crevices and staining at the margins indicate the presence of microleakage with the potential of caries developing with time.

As reported previously (Lui & others, 1987; Varpio, 1985), the cervical margin had the greatest percentage of defects and staining, and is obviously the Achilles heel of the class 2 composite restorations. SEM evaluation of the margins confirmed that the cervical margin is the most prone to defects. The results of this study confirm that good clinical performance is obtained in the occlusal margins, and that the cervical margins present a problem in class 2 composite restorations.

Although clear matrices and wedges with light-reflecting surfaces have been introduced in an attempt to reduce shrinkage away from the gingival margin, the authors feel that the dimension of the defects found in this study are not predominantly the result of shrinkage but a combi-





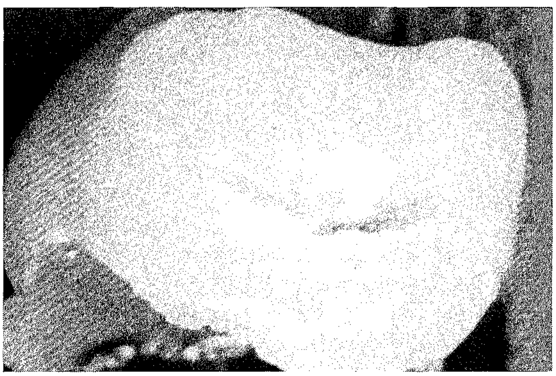


FIG 4A, 4B, and 4C. *Clinical photographs of the approximal surfaces of three retrieved primary molars. FIG 4A shows excellent margins; FIGS 4B and 4C demonstrate marginal staining and a crevice along the gingival margins. Note acceptable buccal and lingual margins in FIG 4B.*

nation of factors such as thin enamel and poor adherence of the material to the cervical margin, and particularly the difficulty of condensation of the material to the gingival wall.

Conclusions

It was concluded that clinical examination of class 2 composite alone will not detect a large percentage of failures at the gingival margin of

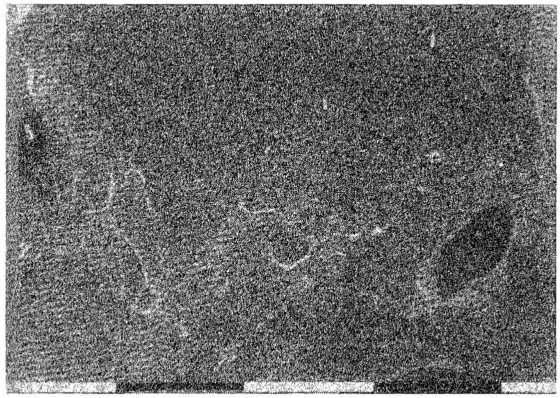


FIG 5. *Photomicrograph (X20) of the approximal surface shown in FIG 4A; defect in the linguo-cervical angle is clearly evident, even though it was not noticed during the visual tactile evaluation (Bar = 1 mm).*

the approximal box; therefore, evaluation of the approximal surfaces and margins is imperative before recommendation can be made for the routine use of class 2 composite restoration.

(Received 28 October 1987)

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Thermal Expansion of Visible-light-cured Composite Resins

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Summary

Linear coefficients of thermal expansion were measured on seven visible-light-cured composite resins from 0 to 60 °C. The values ranged from 29.0 to 83.5 x 10^{-6}/ °C at 37 °C. Statistical analysis revealed significant differences among temperature ranges and products and between runs. Significant correlation was not found between the coefficient of thermal expansion and volume fraction of filler particles.

Introduction

Recently, the use of visible-light-cured composite resins has been very popular in the field of operative dentistry because of their clinical advantages. Compared to self-cured composites, the physical and mechanical properties of the light-cured composites are better, and color matching and control of setting time are easier. Some problems still exist, however, such as longevity of bonding, limited depth of cure, durability against occlusal stress, and potential irritation to pulp. Thermal expansion also cannot be considered much improved.

Many investigations have been performed with conventional and microfilled self-cured composite resins. According to a previous study (Powers, Hostetler & Dennison, 1979), linear coefficients of thermal expansion of seven commercial composite resins ranged from 26.5 to 39.6 x 10^{-6}/°C, while those of four pit-and-fissure sealants were from 70.9 to 93.7 x 10^{-6}/ °C. Raptis, Fan and Powers (1979) evaluated properties of four commercial microfilled composite resins, a visible-light-cured composite resin, and a con-

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ventional composite resin. The linear coefficient of thermal expansion of a visible-light-cured composite resin was 25.1 x 10^{-6}/ °C, which was relatively smaller than that of the microfilled composite resins.

Lately, many commercial products have been developed and released by various manufacturers. Information about the properties of visible-light-cured composite resins, however, is not sufficiently available.

In this study, linear coefficients of thermal expansion in three temperature ranges were measured on seven visible-light-cured composite resins.

Materials and Methods

Brand names, shades, and batch numbers of the seven visible-light-cured composite resins tested are listed in Table 1.

Samples (3.7 mm in diameter and 7.7 mm in length) were prepared in a metal die. An incremental curing technique was employed with three segments. Each segment was exposed individually to a Marathon visible-light activating unit (Den-Mat Corp, Santa Maria, CA 93456) for 30 seconds. After removing the sample from the metal die, the light was applied for an additional 60 seconds. Three samples were prepared for each material. All specimens were stored in a dark place for one day before testing.

The measuring procedure was the same as in the previous study (Powers & others, 1979) and is described below. Linear thermal expansion was measured by a thermomechanical analyzer (Model 941, E I DuPont de Nemours & Co, Wilmington, DE 19898). The instrument was balanced, zeroed electrically, and calibrated before measurement. Displacement of the probe was recorded on chart paper in the temperature range of 0-60 °C. To get a stable heating rate of 5 °C/min, the sample was cooled down to -25 °C by liquid nitrogen before testing. Two measurements were obtained consecutively on each material to compare the first and second runs.

The coefficient of thermal expansion was calculated from the slope recorded on the chart paper for three temperature ranges: 0-60 °C, 10-45 °C, and 37 °C. Data were analyzed by a three-way analysis of variance (Dalby, 1968). Means were compared by Tukey multiple comparison intervals at the 95% level of confidence (Guenther, 1964).

Table 1. Batch Number, Shade, and Manufacturer of Materials Tested

MATERIAL	SHADE	BATCH #	MANUFACTURER
Quantum	U	112185	Block Drug Co Jersey City, NJ 07302
Prisma-fil	LYG-B-52	1211855	The L D Caulk Div, Dentsply Int'l Inc Milford, DE 19963
Silux	U	5U1R	3M Dental Products St Paul, MN 55144
Quantum PAC	U	122685	Block Drug Co Jersey City, NJ 07302
Sinterfil	U	40707	Teledyne Getz Elk Grove Village, IL 60007
P-30	U	6J5SP	3M Dental Products St Paul, MN 55144
Herculite	U	61031	Sybron/Kerr Romulus, MI 48174

Results

Table 2 shows linear coefficients of thermal

Table 2. Linear Coefficients of Thermal Expansion of Various Composite Resins

MATERIAL	0 to 60 °C		10 to 45 °C		37 °C	
	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2
Quantum	59.9* (2.7)	58.9 (3.4)	55.6 (1.2)	57.6 (2.8)	64.8 (3.1)	61.5 (4.7)
Prismafil	54.1 (2.1)	49.2 (2.9)	49.1 (1.8)	47.6 (3.5)	58.6 (1.2)	51.8 (2.6)
Silux	51.5 (2.1)	50.8 (1.3)	47.5 (4.5)	50.8 (0.7)	53.2 (3.4)	(54.7) (3.4)
Quantum PAC	37.3 (3.4)	35.1 (3.3)	33.7 (4.1)	34.5 (2.8)	38.6 (3.3)	37.9 (3.4)
Sinterfil	82.8 (5.8)	81.3 (5.6)	83.6 (5.4)	78.3 (3.3)	89.1 (3.1)	83.5 (2.9)
P-30	28.0 (4.7)	26.9 (1.7)	24.8 (4.5)	27.0 (1.2)	29.5 (1.6)	29.0 (1.5)
Herculite	58.7 (1.3)	54.3 (1.7)	54.3 (1.6)	53.4 (0.5)	63.9 (3.1)	59.5 (0.6)

expansion of the seven composite resins over three temperature ranges. Three-way analysis of variance revealed significant differences among the temperature ranges and the products and between the runs. Only the interaction between the products and runs was significant. Tukey intervals for comparisons among temperature ranges and products and between runs were 1.6, 3.6, and 1.1 x 10^{-6}/ °C, respectively.

Generally, the coefficients of thermal expansion were the lowest in the temperature range of 10-45 °C, and the highest at 37 °C, because the expansion curve was not linear throughout the temperature range. In most cases, the coefficients of thermal expansion in the first run were higher than in the second run.

Linear coefficients of thermal expansion varied widely. For instance, the values of P-30 were 28.0 in the first run and 26.9 in the second run in the temperature range of 0-60 °C. Corresponding data of Sinterfil were 82.8 and 81.3; that is, thermal expansion of Sinterfil was three times larger than that of P-30. Among all of the materials tested in this study, the highest coefficient was obtained for Sinterfil. In all temperature ranges, P-30 had the lowest value, followed by Quantum PAC.

Discussion

The linear coefficient of thermal expansion of a tooth is 11.4 x 10^{-6}/ °C (Craig, 1985). In comparison, restorative resins show relatively high thermal expansion. Differences in dimensional change between the restoration and tooth may result in loosening, debonding, and gap formation at the interface.

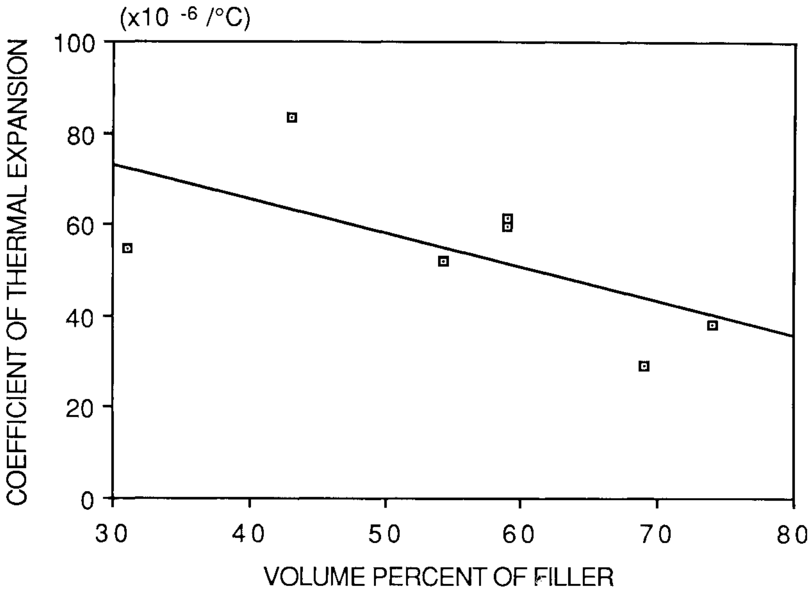
Although Asmussen (1974) reported that temperature change had little effect on adaptation of resin fillings, the bonding condition between the restorative material and the tooth should be important, even if an increase of marginal gap with cooling were not observed. It is desirable that the restorative material have the same coefficient of thermal expansion as the tooth.

As mentioned before, linear coefficients of thermal expansion were found to be different depending on the temperature range because of increased dimensional change between 40-60 °C. This observation also was made by Powers and others (1978), who explained the dimensional change to be the result of release of residual compressive stress. Increased dimensional change above 40 °C was not observed in the second run, so the linear coefficient was larger in the first run than in the second run. The same study reported differences between the two runs, which ranged from 4.7 to 17.4%. Differences between the runs in the present study were small but varied among the products as indicated by the significant interaction term in the ANOVA. The largest difference was 9.1% in Prisma-fil, followed by 7.5% in Herculite, 5.9% in Quantum PAC, 3.9% in P-30, 1.8% in Sinterfil, and 1.7% in Quantum. Silux showed the smallest difference, 1.4%. Overall, the average difference in the present study was approximately half that of the previous study.

Among the materials tested, Quantum, Prisma-fil, and Silux are marketed for anterior restorations, while the other four materials are marketed for posterior use. No particular difference was observed between thermal expansion values of the anterior and posterior composites.

A strong inverse correlation between the filler content and the coefficient of thermal expansion has been reported (Hashinger & Fairhurst, 1984). It also has been suggested that composites with glass filler particles had lower values of thermal expansion than composites with quartz filler particles (Powers & others, 1978). Söderholm (1974) reported a similar conclusion in his study.

According to Farah and Powers (1986) and manufacturer's data, the volume fraction of filler particles in each composite are as follows: Quantum 59%, Prisma-fil 54.3%, Silux 31%, Quantum PAC 74%, Sinterfil 43%, P-30 69%, and Herculite 59%. The correlation between the coefficient of thermal expansion from the second run at 37 °C and the volume fraction of filler particles was determined (see figure): the correlation coefficient (r) was computed to be 0.624, while the critical value was 0.632 at the 95% level of confidence. No significant correlation coefficient was found because Silux, which contained a low proportion of filler, showed a comparatively low thermal coefficient. When the results of Silux were deleted, the correlation coefficient was 0.906. Needless to say, a major factor which affects the thermal expansion of composite resin is the proportional ratio of filler particles in the matrix resin. However, thermal characteristics of the filler particles, composition of the matrix resin, condition of silanate bonding between filler and matrix, and degree of polymerization are potential factors affecting thermal expan-



Correlation between coefficient of thermal expansion and volume fraction of filler

sion. The effects of these factors may explain the results of the present study.

Some may not consider thermal expansion to be an important property of composite resins, but restorations are always exposed to severe thermal stress. We anticipate further improvement of thermal expansion in composite resins in the future.

Conclusion

The linear coefficients of thermal expansion were measured from 0 to 60 °C with a thermomechanical analyzer. Values ranged from 29.0 to 83.5 x 10^{-6}/ °C on the second run at 37 °C. Statistical analysis showed significant differences among the temperature ranges, the products and the runs, and the interaction between products and runs. No significant correlation was observed between the coefficient of thermal expansion and the volume fraction of filler particles in the present study.

(Received 3 November 1987)

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Microleakage Channels: Scanning Electron Microscopic Observation

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Summary

Resin casts were made of microleakage channels surrounding amalgam restorations in vitro. After demineralizing the tooth and digesting the remaining organic matrix, the amalgam restorations covered with the resin casts were examined using a scanning electron microscope. An extensive reticular network of channels was observed on restorations which were placed in cavities lined by smear layers. Amalgam restorations placed in cavities devoid of smear layers exhibited fewer microleakage channels.

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Introduction

Microleakage is the movement of bacteria, fluids, and chemical substances between the tooth and restorations of any type. The phenomenon is clinically important because of recurrent decay and complaints of patient sensitivity to masticatory, thermal, or osmotic stimuli which are often associated with microleakage. It occurs because of the presence of a microscopic fluid-filled space at the interface of the restoration and tooth structure. This space may be created because of the solubility of cements, liners, or bases. It may be a result of differences between the coefficients of expansion of the restorative material and the tooth, or because of inadequate adaption of restorative materials to cavity walls.

It has been demonstrated that the presence of a smear layer increases microleakage (Pashley & Depew, 1986) even though it also decreases dentin permeability. It has been suggested that the smear layer increases microleakage by allowing fluids to pass through it, much like a layer of sand (Pashley, 1984).

Materials and Methods

The purpose of this study was to attempt to visualize the routes or channels through which microleakage may occur around amalgam restorations using scanning electron microscopy in the presence or absence of a smear layer.

The method used in this study was different than the many qualitative and quantitative methods used to study microleakage in the past, in that "casts" were made of microleakage channels (Going, 1979; Jodaikin, 1981). Human, extracted, unerupted third molars were sectioned at the CEJ with a diamond saw (Isomet, Buehler Ltd, Evanston, NJ 08520). The resulting crown segments were cemented to 2 x 2 x 0.6 cm pieces of plexiglass. Class 1 cavity preparations were made using a #330 bur in a high-speed handpiece operated with air/water spray.

After completing the cavity preparations, a hole was drilled through the center of the pulp chamber and through the piece of plexiglass. The diameter of the hole was such that it would accept a force-fitted length of 18-gauge stainless steel tubing. The tubing was flush with the pulpal floor of the cavity at its upper end and extended 2 cm beyond the plexiglass at its other end. The lumen of the tubing was occluded with a length of wire during insertion of the amalgam restoration (Fig 1). Seven teeth were divided into two groups. Group I was composed of teeth #1-4, which served as the control group with intact smear layers. Group II was composed of teeth #5-7, which were acid-etched with 6% citric acid for two minutes to remove the smear layers. All of the cavities were then rinsed with distilled water for 15 seconds, dried, and restored with Dispersalloy amalgam (Johnson & Johnson, East Windsor, NJ 08520). After carving, the amalgams were allowed to set for one hour and the piece of wire in the 18-gauge tubing was removed.

Concise Enamel Bond with fluorescein dye (3M Dental Products, St Paul, MN 55144) was used to make a cast of the routes of microleakage. Equal amounts of catalyst and resin (at about 10 °C) were mixed for 10 seconds. The enamel bond was then drawn up into a 10-cc disposable plastic syringe and then was forced by manual pressure (approximately 30 psi) through the 18-gauge stainless steel tubing. This allowed the resin to flow through the stainless steel tube and around the amalgam via microleakage channels. Pressure was maintained until the resin had completely polymerized (about five minutes).

Two control amalgam restorations were made in which no plastic was forced around them.

Next, the tooth structure was removed by demineralization in 3N formic acid for 14 days followed by 1N KOH for two days with continuous gentle gyratory shaking. Control amalgams were also subjected to formic acid demineralization followed by KOH digestion. Photographs were taken of all surfaces of the remaining amalgam restorations through a dissecting microscope.

The remaining amalgam restorations were coated with gold and examined in an AMR-1000A scanning electron microscope. The samples were examined at numerous points at X20, X50, X100, X200, X500, X1000, and X2000. Photomicrographs were taken of typical sample sites on the pulpal and axial surfaces of the amalgam samples.

In order to determine the thickness of the resin casts of the microleakage channels, some amalgam specimens were embedded in P-30 (3M Dental Products, St Paul, MN 55144) composite resin after being recovered from the teeth. The embedded specimens were then sectioned at right angles to the axial surface and polished with diamond paste.

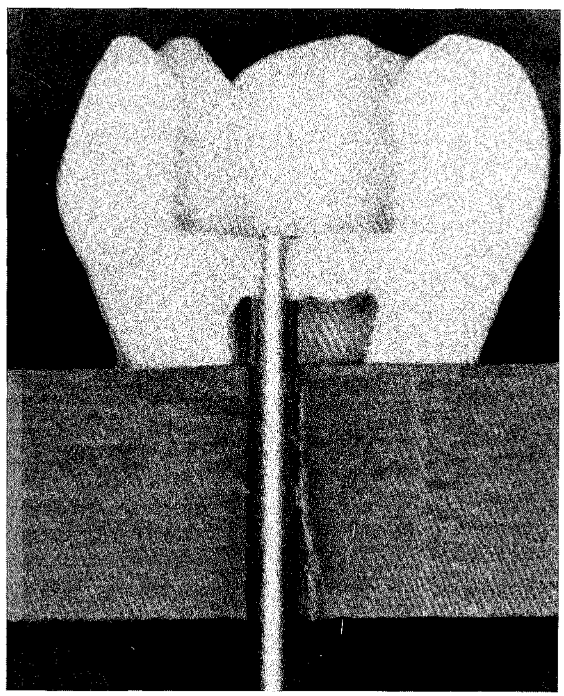

FIG 1. *Cross section of specimen preparations of teeth. The stainless steel tubing bypasses the dentin until it is flush with the cavity floor.*

Results

The results were fairly consistent within the two groups. In the photographs taken with the dissecting microscope, it could be seen that resin had reached the occlusal surfaces of the amalgam restorations creating small yellow deposits of resin only on amalgam specimens 1 through 4, Group I (Fig 2). Additional smaller deposits of resin could be observed if ultraviolet light was used to enhance the fluorescence of the resin. No such resin deposits were observed on amalgam specimens 5 and 7 in Group II, which had been placed in acid-etched cavities.

After subjecting the specimens to demineralization and then digesting the remaining organic matrix with KOH, only the amalgam restorations remained. They were covered by a thin fragile coat of resin which was not evident macroscopically.

When examined by SEM, the plastic appeared as a smooth, glossy material at all magnifications. Amalgam had a highly granular surface, even at magnifications as low as X20 (Fig 3). On amalgams in Group I, a definite continuous network of resin channels was observed on the axial surface from the pulpal line angle to the occlusal line angle virtually circumscribing the entire restorations (Fig 4). The amalgam restorations in Group II revealed no such network, although occasional islands of plastic were observed on the pulpal surface and pulpal-axial line angles. On these islands, delicate casts of dentinal tubules could be observed. When cross sections were examined by SEM, it was revealed that the thickness of the microleakage channels averaged about 6 μm (Fig 5).

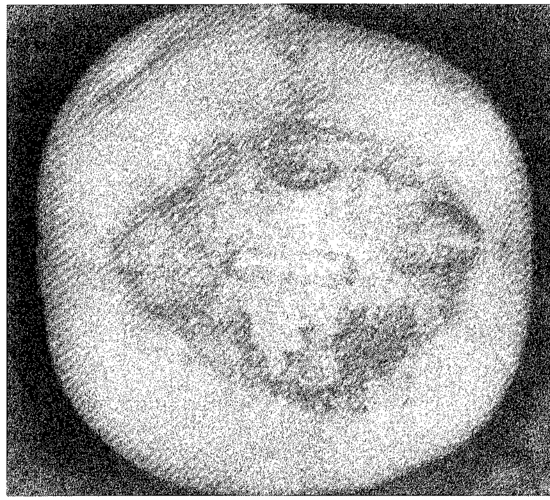

FIG 2. *Photograph of the occlusal surface of a specimen before demineralization, showing the small resin deposits along the margin of the amalgam*

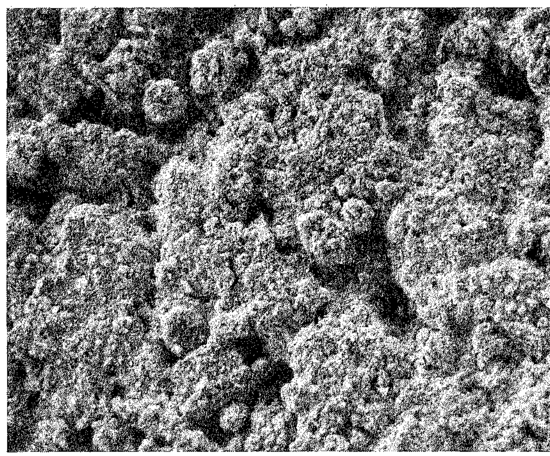

FIG 3. *Photomicrograph of the axial surface of a control amalgam after demineralization, showing the granular appearance of the amalgam (X500)*

Discussion

In our previous research (Pashley & Depew, 1986) it was shown that the presence of a smear layer contributed to microleakage, but if the smear layer was removed by acid etching, the amalgam was able to adapt better to the cavity walls and decrease the interfacial space through which fluid may flow. The observations were made by quantitatively measuring the amount of fluid filtration around amalgam restorations. This fluid had to pass through spaces or channels between the cavity wall and the amalgam restorations. In this follow-up experiment, we demonstrated the presence of spaces through which microleakage may occur by filling those spaces with self-curing unfilled resin. The extensive reticular network of the resin "casts" of these spaces indicates that they are present over all surfaces of the amalgam restorations. The thickness of these resin casts was in the range of 1-10 μm, which was similar to that reported in another study of the interfacial space between tooth and amalgam, which ranged from 5-20 μm (Saltzberg & others, 1976). These dentin casts were easily

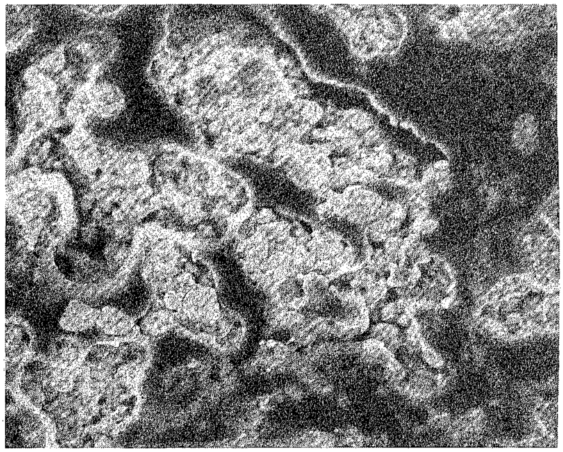

FIG 4. *Photomicrograph of the axial surface of an amalgam sample demonstrating the typical network pattern of microleakage channels reproduced as resin casts (X500)*

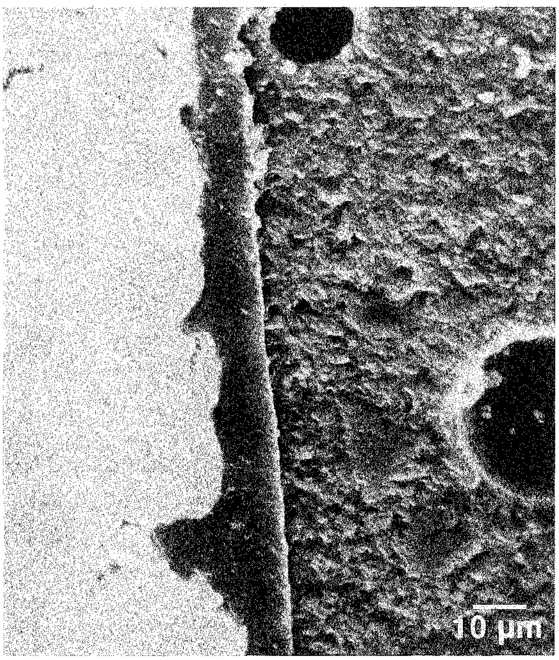

FIG 5. *Photomicrograph of a cross section of the axial surface of an amalgam sample after embedding the sample in P-30. This demonstrates the thickness of the resin casts, which averaged 6 µm (X1000).*

demonstrated on dentin surfaces covered with a smear layer but were rarely seen on acid-etched dentin.

The range in cast thickness (or channel width) undoubtedly depends on the thickness and porosity of the smear layer, the type of restorative material used, and the manner in which it is placed. It would also depend on the solubility of any liner or varnish that was used. There has been discussion of the solubility of cavity varnish, and the insufficient production of corrosion products of newer high-copper amalgams. Although the initial selling properties of varnishes are good, longitudinal studies using high-copper amalgam have shown that microleakage increases over time even when cavity preparations have been sealed with varnish (Smith, Wilson & Combe, 1978; Sneed, Hembree & Welsh, 1984; Derkson, Pashley & Derkson, 1986; Pashley & Depew, 1986). Powell and Daines (1987) successfully demonstrated in vitro that there is a 4-24% loss of varnish weight per week.

Our inability to detect microleakage channels between acid-etched dentin and amalgam does not mean that microleakage could not occur. It simply means that the methods employed could not demonstrate channels. These qualitative results confirm our previous results (Pashley & Depew, 1986). That is, the presence of a smear layer increases microleakage over that seen in the absence of a smear layer. In other studies, it has been shown that removal of the smear layer by acid-etching prior to restoration allows greater adaptation to cavity walls (Qvist & Qvist, 1985). In a study using monkeys, Jodaikin and Austin (1981) demonstrated that removal of the smear layer improved the marginal seal of amalgams. Other authors have implied that the absence of a smear layer would decrease leakage (Derkson & others, 1986; Roydhouse, 1968). Our results should not be construed as an endorsement of acid-etching dentin prior to restoring teeth with amalgam; rather, it indicates that procedures which reduce the thickness of the smear layer such as treatment with the Prophy-Jet, (Gwinnett, 1987) or Tubulicid (Brännström, Nordenvall & Glantz, 1980) or polyacrylic acid (Berry, von der Lehr & Herrin, 1987) may reduce microleakage by permitting closer adaption of dental materials to the walls of the preparation. Smear layers should be regarded as moist, plastic, deformable layers 1-10 µm thick, which provide a substrate for microleakage channel formation. The smear plugs beneath the smear layer are responsible for reducing dentin permeability. The smear layer which accumulates above the smear plugs is not nearly as important as the plugs.

Conclusions

Although the smear layer serves as a cavity liner and seals dentinal tubules, most of the reduction in dentin permeability is due to the presence of smear plugs within the tubules. The overlying smear layer may interfere with the close apposition of restorative materials to enamel and dentin. Further research should be designed to reduce or eliminate the smear layer without eliminating smear plugs.

Acknowledgements

This work was supported, in part, by grant DE 06427 from the National Institute of Dental Research.

The authors are grateful to Mrs Eillen D Cranford and Sandy Bolton for their secretarial assistance and to Dr Robert Erikson, 3M, for supplying the fluorescein-labeled resin.

(Received 9 December 1987)

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Variations in the Design of #330 Dental Burs

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Summary

This evaluation consisted of a photographic evaluation of eight brands of commercially available #330 burs; comparisons were made to the standard as set by Dr Miles Markley. They were also evaluated as to their meeting ADA Specification No 23 for dental burs. In a second portion of the study, the burs were used to prepare channels in extracted teeth, and the pattern produced was evaluated. The results indicate that there is a great difference in the shape of the burs produced by the various manufacturers, as there was in the pattern they produced in preparing tooth structure.

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Introduction

An excellent article on the evolution of the amalgam cavity preparation by O'Hara and Clark (1984) includes the change from sharp internal line angles to rounded line angles. Photoelastic studies of stress distribution within a cavity preparation demonstrated that a rounded angle results in more even stress distribution (Mahler, 1958; Granath, 1964a, 1964b). Dr Miles Markley's attempts to obtain a bur that would produce a flat pulpal floor, rounded internal line angles, and converging facial and lingual walls resulted in the production of the first pear-shaped #330 bur in 1957 (Christen, 1978). The rounded internal line angles for amalgam preparations are now accepted and taught in the majority of North American dental schools (O'Hara & Clark, 1984), and in response to the demand, several manufacturers now produce similarly designed burs.

Materials and Methods

Clinical experience with the #330 bur made by different manufacturers indicated a possible difference in cutting patterns produced and it was decided to do a comparative study of the cuts in dentin resulting from burs supplied by various manufacturers. Inquiries to several dental sup-

Table 1. Manufacturers of #330 Burs

1	Ash	Ash-USA, Div of Dentsply International, York, PA 17405
2	Brasseler	Brasseler USA, Inc, Lombard, IL 60148
3	Busch	Pfingst & Co, Inc, South Plainfield, NJ 07080
4	Densco	Teledyne Getz, Emesco Div, Elk Grove Village, IL 60007
5	Meisinger	Swiss American Metalcraft Corp, Concord, CA 94520
6	Midwest	Midwest American, Des Plaines, IL 60018
7	R & R	Ransom & Randolph Co, Toledo, OH 34604
8	S S White	S S White Co, Holmdel NJ 07733

pliers identified eight different manufacturers of the #330 bur, as listed in Table 1.

Six burs from each manufacturer were cleaned in an ultrasonic bath and examined and photographed with the use of a Unitron ZST Stereo Microscope (Unitron Instruments, Plainview, NY 11803) (Figures 1a-8a). The cutting pattern produced by each bur was evaluated using extracted teeth that had been stored in a 1:1 solution of glycerine and 70% alcohol. The occlusal surface of each tooth was ground flat on a model trimmer until all enamel was removed. The enamel on the axial walls of the crowns was removed with a high-speed diamond stone using air/water spray. Each type of bur was placed into a high-speed handpiece and a straight channel was cut across the dentin while attempting to cut to the full depth of the bur head. The bur channels were filled with inlay wax to provide contrast for photography. Cross sections of each channel were produced with a fine diamond stone followed by a medium-grit cuttle disk. Each channel was photographed with the same equipment used to photograph the burs (Figures 1b-8b).

Results and Discussion

Specification No 23 for dental excavating burs (Council on Dental Materials and Devices, 1975) lists the required head diameter and length for #330 burs, and in this regard, all of the bur samples tested met the specifications (Table 2). The amount of taper between the sides of the bur, the roundness of the corners and the flatness of the end of the bur are not specified. Variations in these nonspecified dimensions and considerable differences in the length of the head resulted in a variety of cutting patterns produced by the various burs.

The cutting patterns produced by the Brasseler, Midwest, R & R and S S White burs (Figs 2a, 2b, 6a, 6b, 7a, 7b, 8a, & 8b) most closely resemble the conservative type preparation advocated by Markley (1984) and described in more detail by Almquist, Cowan and Lambert (1973). The Busch and Densco burs (Figs 3a, 3b, 4a, & 4b) produced a V-shaped pulpal floor, while the Ash and Meisinger burs (Figs 3b & 5b) created a round floor. In addition, the head length of the Ash bur (1.3 mm) is too short to reach the dentin with a single pass of the bur in most teeth. The Busch bur exhibited a very coarse finish with rough, chipped cutting edges on all six samples provided. The R & R bur was produced with a metal bur at the top of the head which would retain cutting debris and would be almost impossible to adequately clean.

Conclusions

Critical examination of the dentin channels cut by #330 burs made by eight different manufacturers demonstrated considerable variations in the type of cutting pattern produced. To cut a conservative amalgam cavity preparation as advocated by Markley (1984), the Brasseler, Midwest, or S S White burs are preferable.

Table 2. Dimensions of #330 Burs (in millimeters)

		Head diameter	Head length	Total length
ANSI/ADA Specs		.80 .08	.90 min.	19.00 .50
1	Ash	.85	1.3	19.6
2	Brasseler	.80	1.7	16.6*
3	Busch	.83	1.6	18.9
4	Densco	.85	1.7	18.5
5	Meisinger	.80	1.8	18.7
6	Midwest	.80	1.9	19.4
7	R & R	.80	1.7	19.0
8	S S White	.83	1.9	19.4
	Variation	.03	.6	2.8

*Brasseler bur meets ADA Specification for class 4b dental burs (friction grip, short)

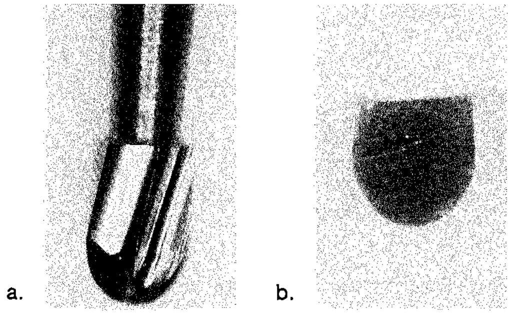

FIG 1. *Ash #330 dental bur (a) and typical cutting pattern (b)*

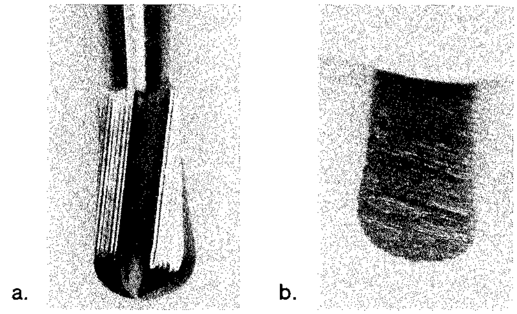

FIG 2. *Brasseler #330 dental bur (a) and typical cutting pattern (b)*

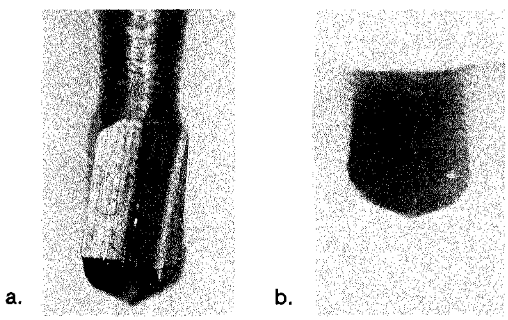

FIG 3. *Busch #330 dental bur (a) and typical cutting pattern (b)*

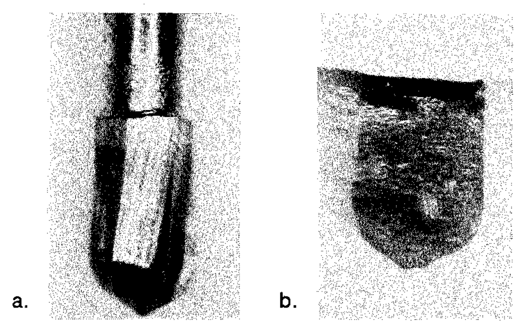

FIG 4. *Densco #330 dental bur (a) and typical cutting pattern (b)*

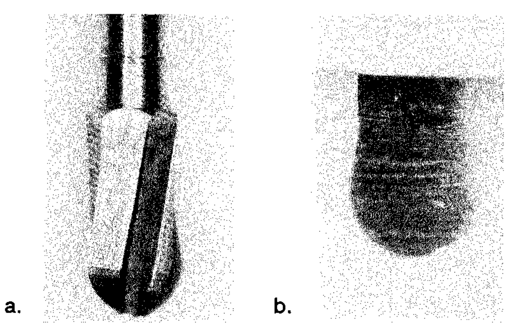

FIG 5. *Meisinger #330 dental bur (a) and typical cutting pattern (b)*

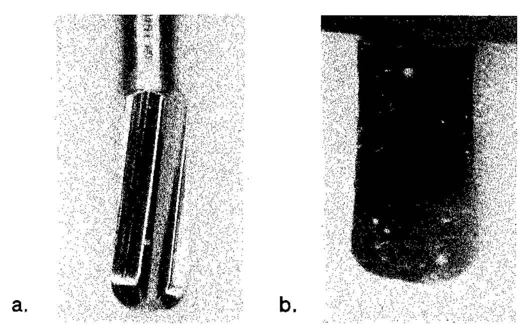

FIG 6. *Midwest #330 dental bur (a) and typical cutting pattern (b)*

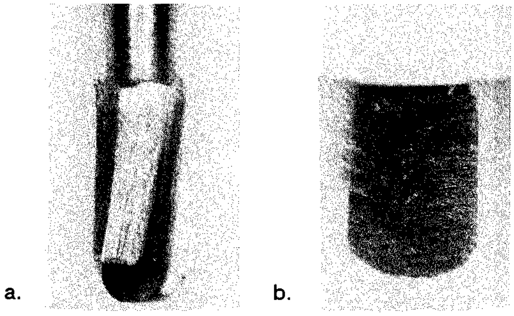

FIG 7. *R & R #330 dental bur (a) and typical cutting pattern (b)*

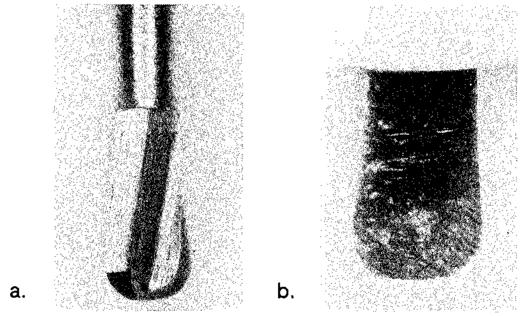

FIG 8. *S S White #330 dental bur (a) and typical cutting pattern (b)*

(Received 6 November 1987)

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Antimicrobial Properties of Glass-ionomer Cements and Other Restorative Materials

WARREN SCHERER • NITA LIPPMAN • JAMES KAIM

Summary

The antimicrobial properties of 14 different restorative materials, nine of which were glass-ionomer cements, were compared and observed in this study. The materials were mixed according to manufacturers' specifications and exposed to four types of bacteria commonly found in caries and plaque. Zones of bacterial inhibition were measured for all materials in millimeters. Glass-ionomer cement materials, materials containing zinc oxide, and amalgam produced measureable zones of inhibition.

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Introduction

Acid-etch techniques developed by Buonocore have helped to reduce or eliminate microleakage in etched-enamel-to-composite-resin bonds (Buonocore, 1955). These techniques, however, have not been successful in procedures involving dentin, where the fluid in dentinal tubules wets the dentin surface and prevents adhesion and maximum bond strength. In addition, Hembree and Andrews have demonstrated that polymerization shrinkage of composite resin can cause significant microleakage on margins that do not end on enamel, (Hembree & Andrews, 1978) which results in gaps between the restorative material and tooth structure (Munksgaard, Hansen & Asmussen, 1984). A number of investigators (Brännström & Vojinović, 1976; Paterson, 1976) have implicated bacterial infiltration at such interfaces as contributing to postoperative sensitivity, especially in restorations where margins do not end on enamel (Brännström, 1984). Research also has shown that bacteria flourishing on cavity walls and floors under such restorations cause and/or contribute to pulpal sensitivity (Brännström & Nybörg, 1960).

In spite of these problems, glass-ionomer cements shrink minimally upon setting, chemically bond to dentin, and have shown much promise as restorative materials and lining cements in dentin bonding. Glass-ionomer cements also possess antimicrobial characteristics (McComb & Ericson, 1987) and are considered anticariogenic because of their fluoride-releasing capabilities. Investigators also believe that plaque formation adjacent to these materials may be lessened because of fluoride adsorption by enamel and dentin (Mount, 1984).

The purpose of this study is to compare the antimicrobial effect of several restorative materials, including glass-ionomer cements, when these materials are exposed to four types of bacteria typically found in caries and plaque.

Methods and Materials

This study will compare and measure zones of bacterial inhibition produced by the following materials:

Glass-ionomer cement liners/bases:

1. Ketac-Bond (ESPE/Premier Dental Products Co, Norristown, PA 19404)
2. G-C Lining Cement (G-C International Corp, Scottsdale, AZ 85260)
3. Shofu lining cement (Shofu Dental Corp, Menlo Park, CA 94025)
4. Shofu GlasIonomer base cement (Shofu Dental Corp)
5. Zionomer lining cement (Den-Mat Corp, Santa Maria, CA 93456)

Glass-ionomer cement restorative materials:

6. Ketac-fil (ESPE/Premier Dental Products Co)
7. Ketac Silver (ESPE/Premier Dental Products Co)
8. Shofu Glass-Ionomer Cement - Type II (Shofu Dental Corp)
9. G-C Fuji Ionomer - Type II (G-C International Corp)

Other restorative materials:

10. Dispersalloy amalgam (Johnson & Johnson Dental Products Co, East Windsor, NJ 08520)
11. Visio-Fil composite (Johnson & Johnson Dental Products Co)
12. FluorEver composite (Essential Dental Systems, Inc, New York, NY 10018)
13. Durelon carboxylate cement (ESPE/Premier Dental Products Co)
14. Zinc-oxide powder (Sultan Dental Products, Englewood, NJ 07631)

The following organisms, provided by the Department of Microbiology, New York University College of Dentistry, were used in this study:

1. *Streptococcus mutans* (serotype P-4)
2. *Actinomyces viscosus* (NY-sph)
3. *Lactobacillus salivarius* [ATCC (subspecies *salivarius*]
4. *Streptococcus salivarius* (Mid-West Culture Service)

Streptococcus mutans, Streptococcus salivarius, and *Actinomyces viscosus* were cultured in yeast-glucose broth. *Lactobacillus salivarius* was cultured in brain-heart infusion broth. Assays were performed on blood-agar plates for *Streptococcus mutansi, Streptococcus salivarius*, and *Actinomyces viscosus*. *Lactobacillus salivarius* was plated out on brain-heart infusion agar.

The bacteria were swabbed onto petri dishes with a sterile cotton applicator. Each material tested, except the zinc-oxide powder, was mixed according to the manufacturer's specifications and then placed at a predesignated area (3-4 mm in diameter) on streaked plates. The two composite materials, Visio-Fil and FluorEver, were cured with a VCL 300 Demetron Light-curing Unit placed 2 mm from the specimens for 40 seconds. Thus all materials were allowed to interact with the four different types of bacteria. No more than five materials were placed on any one plate at a time.

Streptococcus mutans and *Streptococcus salivarius* were incubated at 37 °C in 10% CO_2. *Lactobacillus salivarius* was grown anaerobically at 37 °C, and *Actinomyces viscosus* was grown aerobically. After 48 hours, the Petri dishes

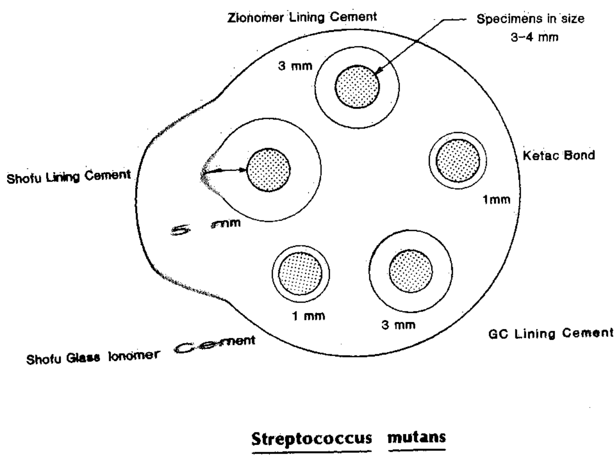

FIG 1. *Lining/base cements interacting with* Streptococcus mutans *bacteria*

were evaluated and the zones of microbial inhibition (inhibition halo effect) measured in millimeters (Fig 1).

Results

Durelon carboxylate cement and zinc-oxide powder exhibited the largest zones of inhibition with *Streptococcus mutans* compared to the other materials. All glass-ionomer cements produced zones of inhibition with the Shofu lining cement and the Shofu GlasIonomer cement Type II materials producing the largest among them. The smallest zones of inhibition were produced by the Visio-Fil and FluorEver composite materials. Visio-Fil produced no zone of inhibition, and the zone of inhibition for FluorEver was 0.5 mm (Fig 2).

All restorative materials except for Visio-Fil (0.0 mm) produced zones of inhibition with *Actinomyces viscosus*. Of the glass-ionomer cement liner/base materials, Ketac-Bond and Shofu GlasIonomer base cement produced zones of inhibition of 0.0 mm and 0.5 mm, respectively. The other glass-ionomer cement liner/base materials produced zones of inhibition ranging from 1.0 mm to 4.0 mm.

The zones of inhibition produced by materials in contact with *Streptococcus salivarius* were as follows: The glass-ionomer cement liner/base materials varied from 0.0 mm (Ketac-Bond) 5.0 mm (G-C and Shofu lining cements). restorative materials except for Durelon carbc ylate cements (3.5 mm) and zinc oxide (2.0 mı produced minimal zones of inhibition (0.0 mn 1.0 mm).

The results obtained with *Lactobacillus sa varius* were quite varied. The glass-ionom cement liner/base materials produced zones inhibition ranging from 0.0 mm to 5.0 mm. Re storative materials produced zones of inhibitio ranging from 0.0 mm to 2.5 mm.

Discussion

This study determined the antimicrobial nature of several glass-ionomer cements and restorative materials in contact with bacteria found in decay and plaque. The antimicrobial nature of the glass-ionomer cements may be related to the low pH levels while setting and to their fluoride-leaching capabilities (McComb & Ericson, 1987). Maldonado, Swartz and Phillips (1978) found that glass-ionomer cements released the greatest amount of fluoride the first few days after set, and Forsten (1977) reported that glass-ionomer cements released a greater amount of fluoride than do silicate cements.

All of the glass-ionomer cement liner/base materials used in this study have shown antimicrobial properties; however, Ketac-Bond and Shofu GlasIonomer base cement produced minimal zones of inhibition with the bacteria tested. These two glass-ionomer cements do not contain zinc oxide. Durelon carboxylate cement, which contains 92% zinc-oxide powder and 4% fluoride, and the zinc-oxide powder material itself, produced zones of microbial inhibition, especially with *Streptococcus mutans*. The zones of bacterial inhibition produced with the glass-ionomer cement liner/base materials may be thus attributed to the zinc-oxide component of the material in addition to their fluoride-leaching ability. It should also be noted that cations, such as zinc, calcium, or magnesium, have a specific potency or efficiency for bacterial inhibition (Winslow & Haywood, 1931). Thus, the antimicrobial nature of these materials may also be attributed to their cationic effects.

The glass-ionomer cement restorative materials all showed zones of microbial inhibition except for the Fuji Type II and the Shofu Glass

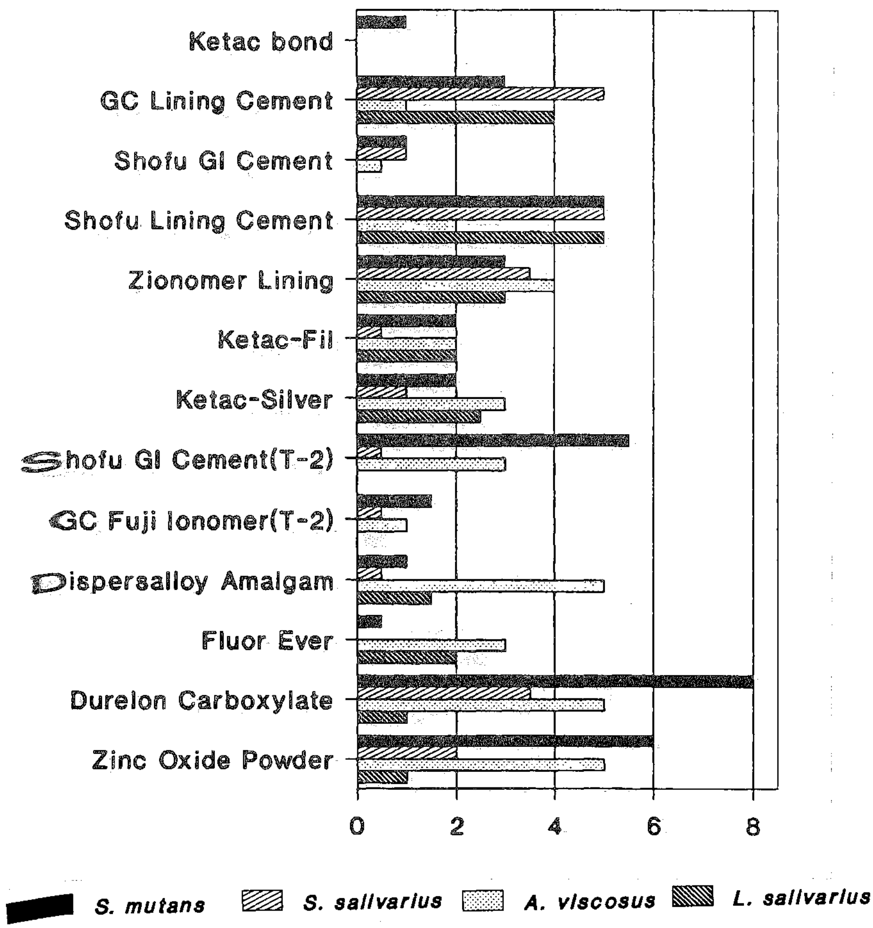

FIG 2. *Zones of inhibition produced by restorative materials with* Streptococcus mutans, Actinomyces viscosus, Streptococcus salivarius, *and* Lactobacillus salivarius *bacteria.*

Ionomer Type II materials, where no zones of inhibition were found with *Lactobacillus salivarius*. The glass-ionomer cement restorative materials exhibited large zones of inhibition as a group with *Actinomyces viscosus*, compared to the glass-ionomer cement liner/base materials (except for the Zionomer lining cement). This bacteria has been found to be present in plaque and has been implicated in the process of the development of root caries.

The amalgam used in this study, Dispersalloy, produced zones of inhibition with all four species of bacteria, with the largest zone of inhibition produced by *Actinomyces viscosus*. It is commonly believed that the material's high copper content may be the major reason for the inhibition (Marshall, 1920).

The composite material Visio-Fil showed no zones of inhibition with any of the bacteria used in this study; however, zones of inhibition were observed with the composite FluorEver. According to the manufacturer, FluorEver contains fluoride that is supposed to be released after the material has been set. Since this product is relatively new, more research must be done to substantiate the manufacturer's claims.

Conclusions

1. Glass-ionomer cement materials used as liners/bases and restorative materials produced

zones of inhibition with the four bacteria used in this study.

2. The glass-ionomer cement liner/base materials which contain zinc oxide produced zones of inhibition larger than did those not containing zinc oxide.

3. The composite material, FluorEver, is capable of producing zones of microbial inhibition.

4. Dispersalloy amalgam produced zones of inhibition with all bacteria used in this study.

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Evaluation of the Ability of Glass-ionomer Cement to Bond to Glass-ionomer Cement

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JAMES M KAIM • MARVIN HAMBURG

Summary

This study investigated the cohesive bond strengths of glass-ionomer cement at three setting and etching intervals and compared these bonds to the shear strength of the material itself. Bonded cylinders were created and then sheared using the Instron Universal Testing Machine. Analysis of bond values of glass ionomer added to glass ionomer indicate bond variability and low cohesive bond strength of the material. Bond values of unbonded glass-ionomer material indicate that the material itself is stronger than bonds established between bonded samples.

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INTRODUCTION

Wilson and Kent introduced glass-ionomer cements to the dental profession during the 1970s (Wilson & Kent, 1972). In recent years, glass ionomers increasingly have become the bases and liners of choice in posterior composites and for restoring root caries with and without composite veneers.

Glass ionomers are composed of an ion-leaching glass powder combined with polyacrylic acid or copolymers of polyacrylic acid. Setting occurs in four stages (Mount, 1984): salt formation, gelation, hardening, hydration (water bound to gel, salts, acid groups).

The calcium polyacrylate salts formed are initially sensitive to moisture. As the reaction proceeds, the aluminum polycarboxylate salts cross-link with the previously formed calcium-salt matrix. The glass-ionomer cement is sensitive to dehydration during hydration, so it is usually protected by a coating of either waterproof varnish or unfilled resin.

In order to repair faulty restorations, researchers have suggested that it may be possible to add new glass-ionomer material to existing glass-ionomer restorations (Hunt, 1984; McLean & Gasser, 1985). In such cases, retention of the added glass-ionomer restorative material may be improved by acid-etching the previously placed glass-ionomer cement (McLean & others, 1985). The purpose of this investigation was to determine:

1. the effect of the primary glass-ionomer material's degree of set on the cohesive bond strength of glass-ionomer restorative to glass-ionomer restorative,
2. the effect of the primary glass-ionomer material's degree of etching upon the cohesive bond strength of glass-ionomer restorative to glass-ionomer restorative, and
3. the cohesive bond strength of glass-ionomer restorative material to glass-ionomer restorative material relative to glass ionomer's shear strength.

METHODS AND MATERIALS

The effect of set time was studied by varying the time interval between the placement of the primary layer of glass-ionomer restorative material and the second layer of the same material (Ketac-fil (ESPE/Premier Corp, Norristown, PA 19404). The Ketac-fil was mixed according to the manufacturer's specifications and syringed into one end of a stainless steel cylinder (7 mm in diameter, 28 mm long) vertically positioned on a glass slab. To prevent dehydration, the top of the cylinder was covered by a mylar strip and the area of contact between the lower end of the cylinder and the glass slab was surrounded by unfilled resin (Visio-Bond, ESPE/Premier).

Application of the Secondary Layer

A second cylinder of the same diameter was placed on top of the cylinder containing the primary layer of Ketac-fil. The combined structure was oriented so that the end of the primary cylinder that had been in contact with the glass slab was now in contact with the secondary cylinder. The second one was then filled with Ketac-fil.

Once again, in order to avoid dehydration, a clear mylar strip was placed over the open end of the second cylinder and unfilled resin was placed at the junction of the two units.

A total of 100 samples was utilized in this study. Three groups of 30 samples each were created with the Ketac-fil-filled cylinder setting time of five minutes, 15 minutes, and 24 hours (table). The times selected were based on common clinical usage. Five minutes reflects the time that class 5 restorations are commonly covered by a matrix. Fifteen minutes represents the initial setting as the finishing time suggested by the manufacturer. Twenty-four hours represents the time it takes for the material to reach a more mature set. In the 24-hour setting group, samples were placed in distilled water at 37 °C after the initial 15-minute setting period.

Each of the three groups were subdivided into three equal subgroups to test the degree of etch applied to the primary glass-ionomer material's surface. Subgroup A received no etch. Subgroups B and C were etched with a gel (ESPE Gel Etchant, ESPE/Premier) for 30 seconds and 60 seconds, respectively. All specimens were rinsed for 40 seconds and then air-dried for 15 seconds. All bonded samples were allowed to remain undisturbed for 15 minutes, after which time they were placed in a distilled water bath

GROUP I		GROUP II		GROUP III	
5-min set		15-min set		24-hour set	
0-second etch (10 specimens)	SUBGROUP A	0-second etch (10 specimens)	SUBGROUP A	0-second etch (10 specimens)	SUBGROUP A
30-second etch (10 specimens)	SUBGROUP B	30-second etch (10 specimens)	SUBGROUP B	30-second etch (10 specimens)	SUBGROUP B
60-second etch (10 specimens)	SUBGROUP C	60-second etch (10 specimens)	SUBGROUP C	60-second etch (10 specimens)	SUBGROUP C

Etch and set times used in study

at 37 °C for 24 hours before testing.

Shear Strength of Glass-ionomer Cement

Ten additional samples were created to test the shear-bond strength of unbonded Ketac-fil. The same type of cylinders used in the bond-strength part of this study were vertically positioned on a glass slab and both were then filled with glass-ionomer material. The result was a double cylinder of unbonded Ketac-fil. These samples were allowed to set for 15 minutes and then they were placed in a 37 °C distilled water bath for 24 hours to allow for complete setting.

Cylinders were secured in a vise, and shear-bond tests were ascertained by using the Instron Universal Testing Machine. Pressure was exerted on the samples at the interface of two cylinders. A crosshead rate of 0.2 inches/minute was applied (Fig 1).

RESULTS

The results of the shear-bond tests are shown in Figure 2. Three specimens in Group III separated spontaneously before any shearing tests could be performed. The shear results of 10 unbonded glass-ionomer cement specimens after 24 hours yielded the following values: x = 832.7 psi, (15.7 mPa), SD +/-75.8 (+/-.52 mPa) (Fig 3).

DISCUSSION

Investigators have demonstrated the ability to bond composite resin to glass-ionomer materials by acid-etching the glass ionomer in what has become known as the "laminate" or "sandwich" technique (McLean & others, 1985). However, as the use of glass-ionomer cements as a primary restorative material has increased, the question of how to repair or modify such restorations has remained mostly unanswered. This study investigated the cohesive bond strengths of glass-ionomer cement at three setting and two etching intervals and compared these bonds to the shear strength of the material itself. Analysis of shear-bond values of glass-ionomer cement added to glass-ionomer cement indicate a variability of the bonds and low cohesive bond strength of the material. Cohesive bonds of some significance were noted at the 15-minute, 30-second period. However, even at this point the standard deviation may be too high for reliable clinical predictions. The lowest shear-bond values were noted for the 24-hour-set groups, in which the material had fully set.

The shear-bond values of the unbonded glass-ionomer material indicate that the material itself is stronger than the bonds established between the bonded samples at a significant level ($P < .01$) when compared to all the other specimens.

Acid-etching the glass-ionomer surface changed the matrix portion of a hardened cement (Fig 4). This change in the glass-ionomer cement surface can result in a roughened surface and allow areas of micromechanical retention to be established.

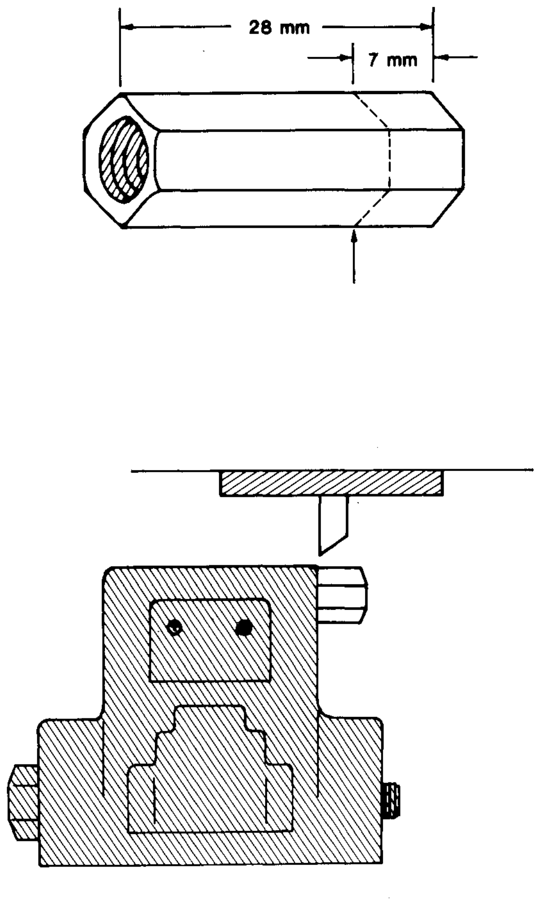
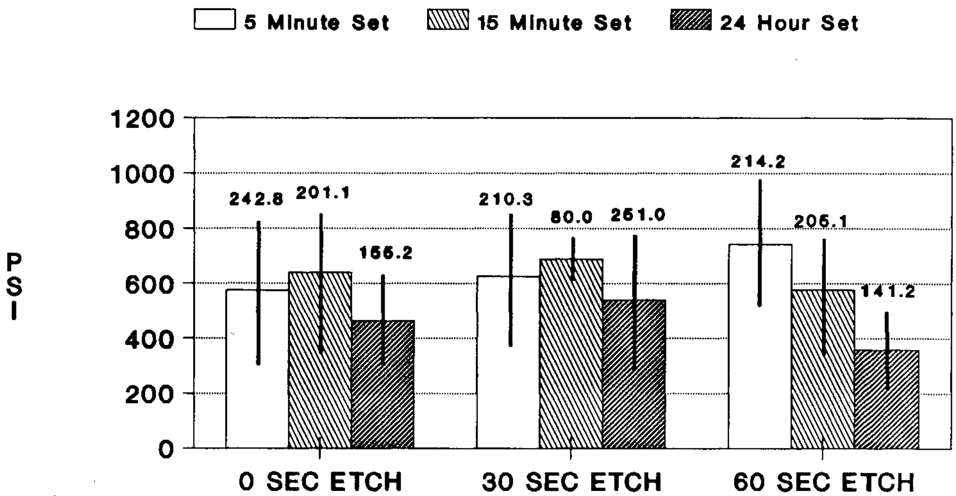


FIG 1. *Cylinders cohesively bonded together; cylinders sheared at interface by Instron Universal Testing Machine*



	0 SEC ETCH	30 SEC ETCH	60 SEC ETCH
5 Minute Set	574.4 (3.9 MPa)	625.3 (4.3 MPa)	742.9 (5.1 MPa)
15 Minute Set	639.7 (4.4 MPa)	688 (4.7 MPa)	577 (3.9 MPa)
24 Hour Set	464.4 (3.2 MPa)	540.5 (3.7 MPa)	359 (2.4 MPa)

FIG 2. *Results: Five-minute set, 15-minute set, and 24 -hour set. Numbers above the bars are the standard deviations.*

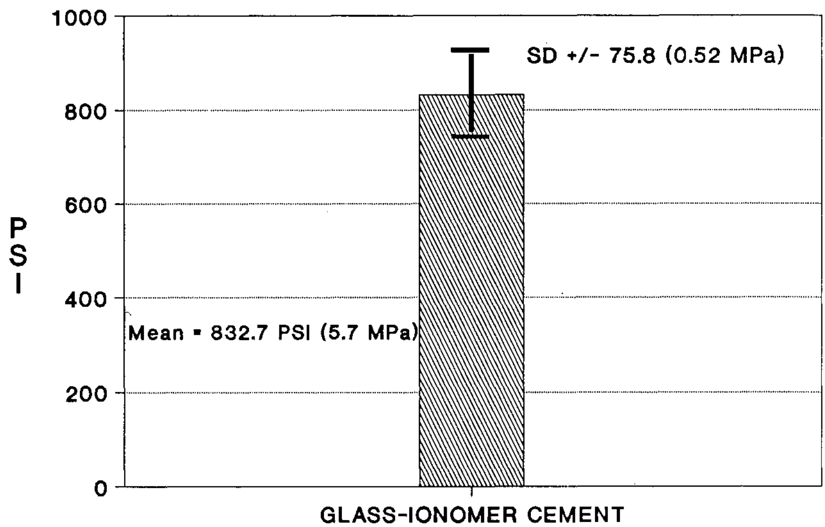


FIG 3. *Shear strength of unbonded glass-ionomer cement specimens*

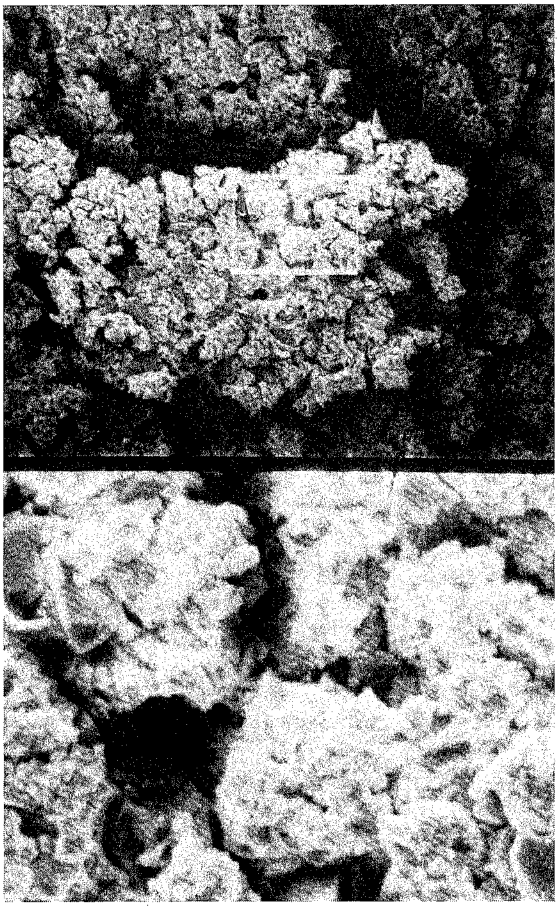


FIG 4. *Glass-ionomer cement allowed to set for 15 minutes and etched for 15 seconds*

Usually, when a composite-resin/glass-ionomer bond is created, the wetting action of an unfilled resin fills these irregularities. Curing the unfilled resin will therefore bond the unfilled resin mechanically to the glass ionomer. The placement of composite resin to the unfilled resin will then result in a chemical union between these two materials and complete the glass-ionomer/composite-resin veneer. However, when two glass-ionomer restoratives are combined, the effect of the unfilled resin's wetting action is missing. Furthermore, the viscosity of the glass-ionomer restorative can prevent an acceptable micromechanical bond from being created.

CONCLUSION

Because the glass-ionomer-to-glass-ionomer bond is so variable, it appears that composite resin should be the material of choice when adding to a previously placed glass-ionomer cement restoration.

(Received 28 December 1987)

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Dentinal Bonding after Chemomechanical Caries Removal–Effect of Surface Topography

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Summary

A study was carried out to determine whether or not the topography of the dentinal surface that is left after caries removal affects bond strength. The caries was removed either by a rotating instrument and a bur or by the chemomechanical method using D,L,2-aminobutyric acid. The bond strength appeared to be enhanced on those specimens treated by the chemomechanical removal since the surface was characterized by lack of a smeared layer and by open dentinal tubules and numerous undercuts.

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Introduction

The search for a means of placing a restoration after caries removal which would adhere to the dentinal surface is widespread. Reports of tests in vitro of both tensile and shear-bond strength of several materials have been reported in many journals (Stanford, Sabri & Jose, 1985; Munksgaard & others, 1985; Munksgaard & Asmussen, 1984; Causton, 1984; Chan, Reinhardt & Schulein, 1985; Solomon & Beech, 1983; Gross, Retief & Bradley, 1985; Bassiouny, 1986). The results are somewhat bewildering for they vary widely.

Buonocore (1955) described a technique for acid-etching enamel to facilitate retention of self-curing acrylic resins. This technique was affirmed as simply a micromechanical lock and it created a very effective bond (Retief, 1978). Since then, other studies (Chalkley & Jensen, 1984; Redford & Jensen, 1985) testing the bond strength of the newly developed chemical bonding agents on enamel have been done and there was no appreciable difference between them. Since the dentinal surface is not as highly calcified as the enamel surface, simple etching does not provide enough strength for the type of mechanical bond that can be obtained in enamel. Asmussen (1985) states that the bond strength of resins to etched dentin is negligible. Thus, the search for a chemical bond is widespread. Dentin bonding agents are mostly bifunctional molecules with a methacrylate group which bonds to the restorative resin by chemical interaction and a functional group that bonds to either the organic or inorganic constituents of dentin.

Recently, a chemomechanical means of removing caries, Caridex (National Patent Dental Products, Inc, New Brunswick, NJ 08901), was introduced to the profession (Goldman & Kronman, 1976; McNierney & Petruzillo, 1986). The solution is a mixture of D,L,2-aminobutyric acid and NaOCl, and, when used with a specially designed pump and applicator tip, has been shown to remove only carious dentin and to have no effect on sound calcified tooth structure (Goldman & Kronman, 1976). In a recent article (Goldman & others, 1987), the surfaces remaining after caries removal were examined with the scanning electron microscope (SEM). They reported that the surface left by the bur was smooth and featureless and covered by a continuous smeared layer. The surface left by the chemomechanical method, which removes only carious material and has no effect on the calcified dentin, had no smeared layer, and the dentinal tubules were completely exposed and open. In addition, the surface was highly irregular and displayed many undercuts.

The purpose of this study was to test the shear-bond strength of various dentin bonding agents on a carious surface cleaned by a bur and on a carious surface cleaned chemomechanically, to determine whether or not the topography and the nature of the dentin surface had any effect on bond strength.

Methods and Materials

One hundred teeth with large carious lesions were stored in water under refrigeration. They were divided into two groups of 50 teeth each. The walls of each cavity were removed with burs and chisels to the level of the carious floor of the cavity, being careful not to remove any caries with the bur. The teeth were mounted in epoxy resin in plastic cyclinders 1 1/4 inches in diameter so that the carious surface was 3 or 4 mm above the epoxy and parallel to the surface (Fig 1). Caries was removed from the teeth in the two groups in the following manner:

Group A: Caries was removed with high speed and water spray until, in the opinion of the operator, only sound dentin remained.

Group B: All caries was removed with the Caridex solution and pump until, in the opinion of the operator, only sound dentin remained.

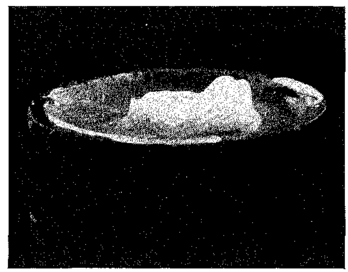

FIG 1. *Photograph of plastic ring with sample mounted, preparation before composite cylinder was placed*

Five materials and their bonding agents were tested.

1. Sealer resin and CuRay-Fil (Scientific Pharmaceuticals, Inc, Duarte, CA 91010).
2. Prisma Universal Bond and Prisma-Fil (LD Caulk Div, Dentsply International, Inc, Milford, DE 19963).
3. Creation 3 + 1 and Ultrabond (Den-Mat Corp, Santa Maria, CA 93456).
4. Scotchbond and P-30 (3M Dental Products, St Paul, MN 55144).
5. Polyacrylic acid and Ketac-fil (ESPE/Premier, Norristown, PA 19404).

The 50 teeth in each group were divided arbitrarily into five groups of 10 teeth each. Thus, each material and bonding agent was used in 10 teeth in which caries had been removed with the bur and in 10 teeth in which the caries had been removed with the Caridex. In each tooth, the bonding agent was applied following precisely the manufacturer's instructions. Following polymerization, a plastic cylinder measuring .0078 inches in diameter and 0.25 inches high was filled with the appropriate filling material and placed as nearly perpendicular to the surface of

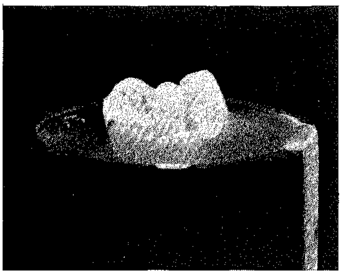

FIG 2. *Photograph of plastic ring with filling sample placed, ready to be tested*

the tooth as possible and polymerized (Fig 2).

In other bonding studies reported in the literature, the bond strength is measured on a flat surface prepared in dentin. In the present study, it was necessary to deal with a surface from which caries had been removed. Thus, an area as flat as possible was chosen to place the cylinder of material to be tested. The teeth were stored in water for a minimum of 48 hours before testing.

The bonds were tested for shear strength to failure in an Instron Testing Machine (Instron Corp, Canton, MA 02021) at a crosshead speed of 0.02 in/min. The results in each group were recorded and subjected to statistical analysis using an analysis of variance and a Bartlett's test.

Results

The table lists the means and standard deviations of the bond strength test. The analysis of variance showed that the bond strength of all the Caridex teeth was significantly better than that of the bur group ($F = 6.38$, $P < 0.01$). The difference between materials was significant ($F = 6.69$, $P < 0.002$). The second filling (Prisma-Universal Bond and Prisma-Fil) was better than all the other materials, both in the bur group and in the Caridex group ($P < 0.001$). All others were not statistically significant. In addition, since there was no interaction, Caridex was better than the bur in each category. Even though the variation around the means is substantial, the findings hold: ($F = 2.02$, $P < 0.10$).

Bartlett's test indicated that there was a statistically significant variation of data around individual groups ($P < 0.02$) and among the groups ($P < 0.01$).

Discussion

One must be circumspect in deriving conclusions from bond strength data. Quantitative measurements are not reliable from case to case. Causton (1984) and Mitchem and Gronas (1985) point out that even the location of the dentin, i e, whether it is close to the pulp or farther away, has a profound effect on bond strengths. As previously noted, many other studies have reported widely varying results when comparing various materials to each other.

It has been shown that thermal cycling and time of storage in water have little effect (Nolden, 1985; Chan, Reinhardt & Boyer, 1985), and that the length of time between the extraction of the teeth and the preparation of the samples had no effect (Mitchem & Gronas, 1985; Williams, Svare & Aquilino, 1985) on bond strength.

The dentinal surface and its effect on bond strength has been given scant attention. Mowery, Parker and Osborne (1986) reported that higher bond strengths were obtained after sanding a flat dentin surface with 60-grit sandpaper instead of 600-grit sandpaper, which seems to be the norm used by many investigators. They state that "although further testing in vitro is deemed necessary, the results of this study stimulate speculation on the possible clinical significance of producing a roughened surface to enhance dentin bonding (retention) of composite resin."

In a previous study (Goldman & others 1987), freshly extracted teeth with large carious lesions

Shear Bond Strengths (PSI)

Material	Bur		Caridex	
	Mean	SD	Mean	SD
Sealer resin and CuRay-Fil	196	123	596	377
Prisma Universal Bond and Prisma-Fil	868	280	1820	981
Creation 3+1 and Ultrabond	484	260	660	432
Scotchbond and P-30	271	185	642	494
Polyacrylic acid and Ketac-Fil	736	756	442	393

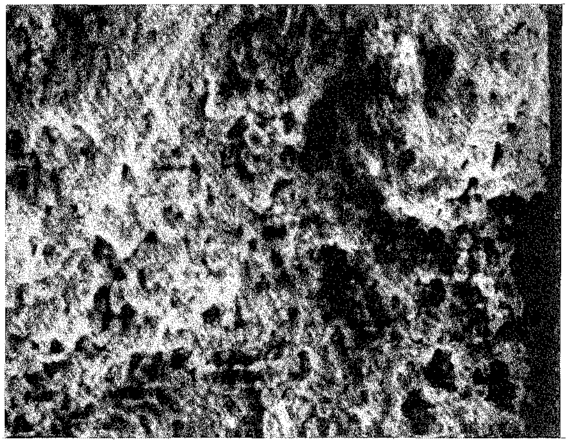

FIG 3. *SEM photomicrograph of dentinal surface after removal of caries with Caridex. Note the absence of a smeared layer, the patent dentinal tubules and the extreme roughness and irregularity of the surface (X82).*

FIG 4. *Higher power of photomicrograph of FIG 3 (X382)*

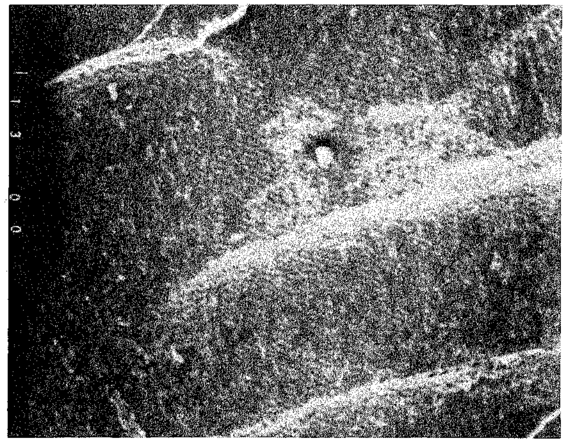

FIG 5. *SEM photomicrograph of dentinal surface after caries removal with small round bur. Note the smooth featureless surface and the presence of the smeared layer obscuring all dentinal anatomy (X41).*

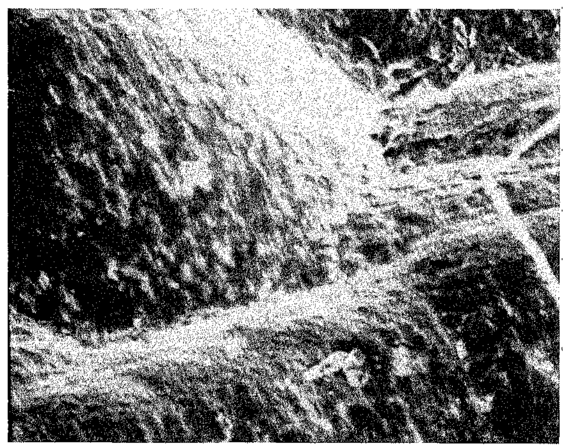

FIG 6. *Higher power of photomicrograph of FIG 5 (X123)*

were divided into two groups. In one group, the caries was removed with a bur until, in the opinion of the operator, no caries remained. In the second group, caries was removed with the Caridex solution until, in the opinion of the operator, no caries remained. The teeth were critical-point dried by placing them in ascending concentrations of alcohol, then in amyl nitrite, which was then removed under proper conditions of temperature and pressure. They were then coated with gold palladium and viewed under the SEM. The SEM photographs (Figs 3-6) clearly show the difference. The surfaces prepared with the chemomechanical solution were highly irregular and there was no smeared layer. The dentinal tubules were clearly visible. The surfaces prepared by the bur were smooth and featureless and covered with a smeared layer. No dentinal tubules were visible.

One can speculate that since the tubules are open and the many irregularities and undercuts present on the Caridex-prepared surface (Figs 3,4) are available and are not decalcified, the bonding agents using a low- viscosity resin plus the various phosphorylated esters are able to establish a strong mechanical lock in addition to a chemical bond, thus producing the higher bond strengths noted in the table. The glass ionomer did not test well since it is too viscous to lock into the microscopic undercuts and the very small dentinal tubules. The surfaces prepared with the bur, on the other hand, are smooth and covered with a smeared layer (Figs 5, 6). Thus, the only retention they have is from any chemical bond that may occur. Since the smeared layer is not firmly attached to the underlying dentin (McComb & Smith, 1975; Moodnik & others, 1975; Goldman & others, 1981), this provides only a relatively low bond strength. The use of an acid with glass-ionomer cement removes the smeared layer and allows a weak bond to form directly to dentin, but it is too viscous to penetrate the tubules and form a mechanical lock. Further studies in vitro on shear strength as well as tensile strength and microleakage studies on the chemomechanical surface versus the surface prepared by a bur are of prime importance.

Conclusions

A shear-strength study utilizing five bonding agents and their appropriate filling materials was done on dentinal surfaces from which caries had been removed either by the bur or chemomechanically using the Caridex system. The bond strengths of the surfaces prepared with the chemomechanical system were statistically much better than the bond strengths of surfaces prepared with the bur. The chemomechanical system was better with each material when compared with the same material on a bur-prepared surface. This is probably due to the differing topography created by the two methods of caries removal. Prisma Universal Bond and Prisma-Fil were statistically the best of all of the materials in both the bur and chemomechanical groups.

(Received 2 February 1988)

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CLINICAL PRACTICE

Adhesive Resin Splint

TAKAO FUSAYAMA

Summary

A technique to splint mobile anterior teeth with a chemically adhesive composite is presented.

Introduction

A chemically adhesive composite resin developed for restoration (Clearfil F II New Bond, Kuraray Co Ltd, Osaka, Japan) is also useful for splinting mobile teeth. In earlier splint fabrications, the composite resin was placed after a preliminary splint with ligature wires was applied; the wire ligatures were removed at the next visit. The recent improvement of the bonding agent has enabled fabrication of the direct resin splint without the preliminary wire splint. This paper presents the technique now popular in Japan.

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Indications

The resin splint method is usually applied to short span splints of two to five units of anterior teeth (Fig 1). This splint is effective when the teeth are subject to the stress of single-direction mastication. A splint of six teeth, canine to canine, is difficult to maintain for long because lateral-stress mastication between the two canines causes a heavy bending stress. The length of splint is most often three units. A larger number of units can be splinted if they are in straight alignment. Application of excess resin can also increase the number of units, but esthetics is somewhat sacrificed. The resin bond is not strong enough for a posterior splint that is

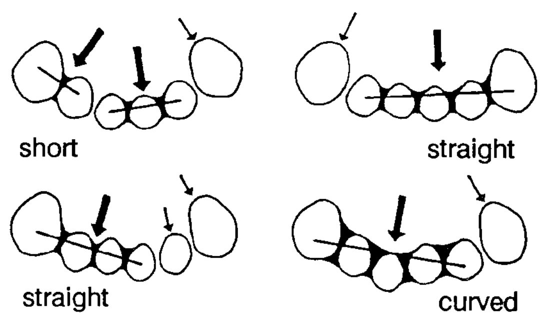


FIG 1. *Indications of adhesive resin splint*

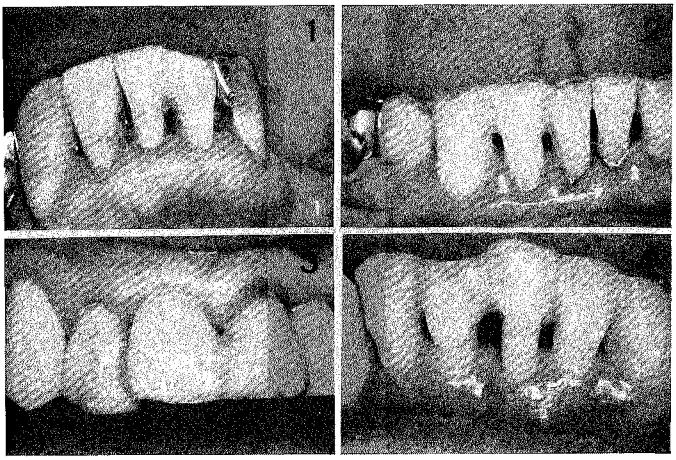


FIG 2. *Clinical cases of adhesive resin splint*

subject to heavy vertical-mastication stress.

Four examples of clinical cases by Clearfil F II New Bond are shown in Figure 2. Case 1 is a two-unit splint of a 57-year-old man. The very mobile central incisor was connected with the stable lateral incisor. This splint was still in service when seen after three years. The teeth in the picture had seven-year-old chemically adhesive composite restorations of wedge-shaped, root-surface defects.

Case 2 is a three-unit splint of a 67-year-old man. The right lateral incisor with poor alveolar bone support was splinted with the teeth on both sides. This splint served for three years until the patient's death.

Case 3 is a three-unit splint of the upper jaw of a 73-year-old man. He occasionally experienced uncomfortable stress from a protrusive central incisor with poor alveolar support. Stabilization of the tooth by means of a splint with the two adjacent teeth relieved the stress and satisfied the patient.

Case 4 is a curved, five-unit splint of a 45-year-old woman treated by Dr N Satou. After a surgical gum operation, the teeth were splinted and the sensitive root surfaces were coated with Clearfil Photo Bond (Kuraray Co) after the dentin surfaces were etched. Excess resin was applied so that the splint could withstand the bending stress of the curved tooth line. The patient appreciated the tooth stability and the desensitization of the root surfaces. The splint is still in service after six months.

Technique

The technical procedure is illustrated in Figure 3.

a) The teeth to be splinted are cleansed with cotton and alcohol, dried with an air syringe, and coated with Protect Varnish (Kuraray Co).

b) The approximal tooth surfaces are slightly reduced using a fine-grain (#280) steel strip to remove the Protect Varnish film and the superficial layer of enamel.

c) The reduced surface is then etched with 40% phosphoric acid jelly, spray-washed, and air-dried.

d) The bonding agent is applied to the etched surface and dried by softly blowing with an air syringe.

e) The self-cured composite mix is then placed in the interproximal spaces around the contact points.

f) The composite is placed with a long-cone composite burnisher (Yamaura Mfg Co, Tabata, Tokyo).

g) When the composite sets, it is trimmed with a top-safe, long-cone, superfine diamond bur (Shofu Co, Kyoto, Japan) and running water. The bite is adjusted.

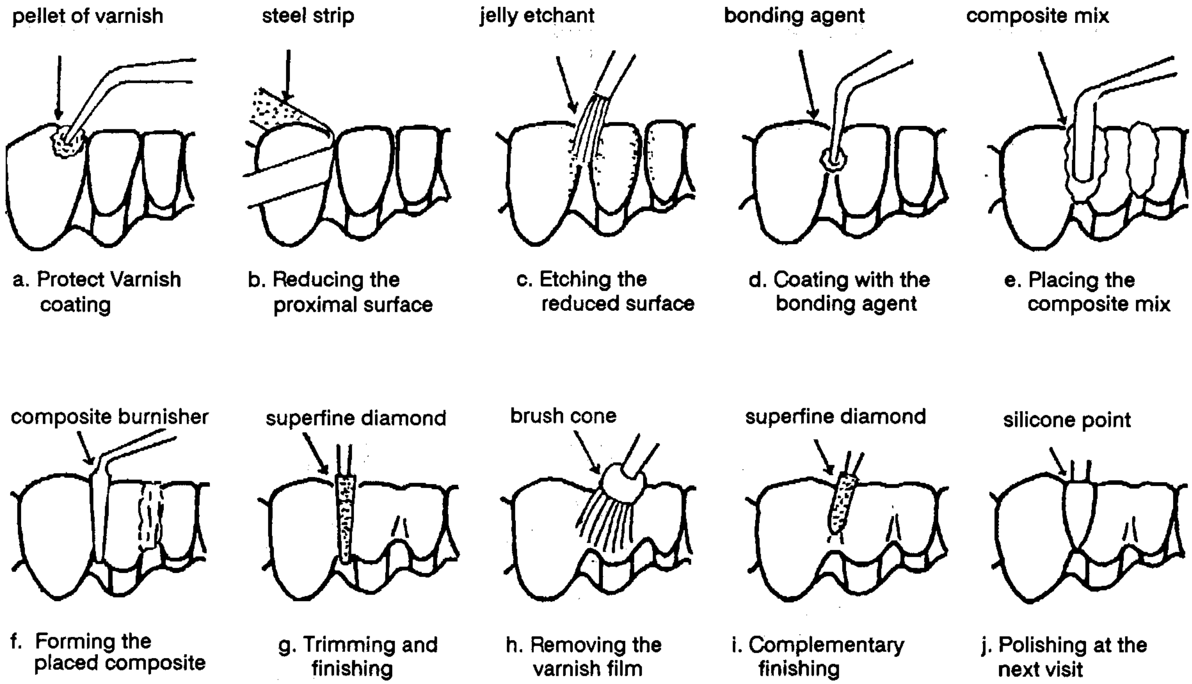


FIG 3. *Technical procedure of adhesive resin splint*

h) The Protect Varnish film is removed with a brush cone (Nihon Shikakogyosha Co, Ueno, Tokyo) and running water.

i) The composite surface is finished with a bullet superfine diamond bur (Shofu Co), removing the residual excess resin.

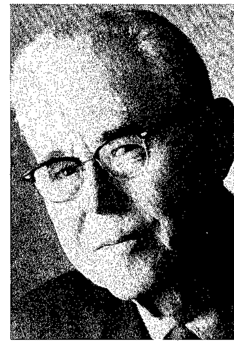
j) At the next appointment, the composite is trimmed and finished, if necessary. It is then polished with a blue silicone bullet point (Shofu Co) and running water.

Conclusions

The technique presented in this paper is currently popular in Japan. The step-by-step procedure presented has been found to work very well in our clinics. It is efficient to place and esthetic in nature.

OPERATIVE DENTISTRY, 1989, **14***, 96,97*

Hollenback Prize for 1989



George Hollenback

The Hollenback Memorial Prize is awarded annually by the Academy of Operative Dentistry in recognition of one who exemplifies high standards of research efforts which have led to improvement in dentistry. Dr George Hollenback was a skilled dentist who believed in progress through research and who appreciated the technical and scientific foundations of his profession. It was this awareness that caused him to investigate and encourage others to study current materials and the methods of their use and to seek new materials which would improve services rendered to patients.

This year's recipient of the Prize is Dr Gerald T Charbeneau, former professor and chairman of the Department of Operative Dentistry at the University of Michigan. It is most appropriate that he receive this award since he, too, has those same skills in dentistry, with great depth in research.

Dr Charbeneau is a native of Michigan and, with the exception of some time spent in education and the military, has maintained his home there. He attended Michigan State Normal College and Baldwin-Wallace College prior to being accepted in the 1944 entering class at the University of Michigan School of Dentistry. He received his Doctor of Dental Surgery degree in 1948, and a Master of Science degree in Pediatric Dentistry from Michigan in 1949. In 1947, he and Margaret were married. They have three children: Thomas, who is a periodontist and associate professor at Baylor; Randall, who is an associate professor of engineering at the University of Texas; and Sue, who is a dental hygienist and works with her husband who practices in Petoskey, Michigan.

After he received his MS, he entered practice part-time while continuing as an instructor in Operative Dentistry and as liaison with Pedodontics at the University. In 1952, he entered the Air Force as a Captain and taught at the School of Aviation Medicine in Montgomery, Alabama. This experience led him to devote his career to education and research.

When he returned to Ann Arbor in 1954, he taught in both the Departments of Operative Dentistry and Dental Materials. These dual activities continued for five years. Promotion has been rapid for him, as befits one of his talents. He became an assistant professor in 1955, associate professor in 1958, and professor in 1965. In 1969, he was named chairman of the department and continued to serve in that capacity until 1986. On June 30, 1988, he retired from full-time teaching but continues on a part-time basis, as well as serving the dental community in other ways.

Dr Charbeneau's research efforts cover a wide range of subjects in dental materials and operative dentistry procedures. These include studies on amalgam, cement, castings and investments, composites, and clinical evaluations. He has worked extensively in the area of pit and fissure sealants and associated adjunct systems. A major interest has been with evaluation procedures on the assessment of student and practice performances and restoration longevity. In addition, his work on glass ionomers and dentin bonding agents is of current interest. He has published over 50 scientific articles. He has authored, co-authored, and contributed to nine texts, some of which have been revised several times. Included are his textbook, *Principles and Practice of Operative Dentistry*, 3rd edition, and *Rating Scales for the Clinical Evaluation of Quality of Performance in Restorative Dentistry*.

Furthermore, Dr Charbeneau has served his school and university with distinction. His primary committee responsibility to the University has been on research, whereas he has served as a member or as chairman of most of the dental school's committees.

He has also given considerable time to organized dentistry and to those programs that support dentistry. He has served as a member of the Council on Dental Materials, Instruments, and Equipment of the American Dental Association; Past President of his District Dental Society; Chairman of the Certification Committee of this Academy; Vice-Chairman of MD156 for Dentistry for the American National Standards Institute; US Technical Advisory Group to the International Standards Organization; Past President of the Dental Materials Group of American Association for Dental Research, and many others. He has served both the National Institute for Dental Research and Federal Drug Administration, the latter as a two-term member of the Dental Devices Panel and is presently chairman.

Gerald T Charbeneau

It is, therefore, an honor for the Academy of Operative Dentistry to present the Hollenback Prize for 1989 to this distinguished researcher, teacher, and public servant.

RICHARD D NORMAN

OPERATIVE DENTISTRY, 1989, 14, 98-100

Award of Excellence

It is a distinct honor for me to present, on behalf of the Academy, the Award of Excellence for this year to a very close friend and colleague.

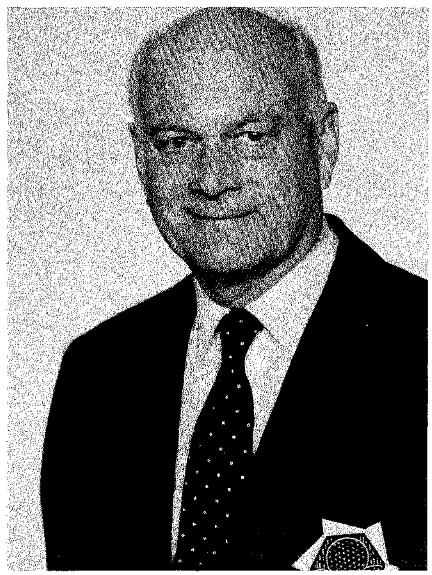
As you know, the criteria for selection for this honor are service to the Academy and teaching and practice of operative dentistry at all levels.

This year's recipient is highly deserving of the honor this Award brings. I would like to bring to you a full picture of his professional life, but my 40 years of close association with him would lead me on indefinitely, like a campaigning politician, so I shall treat the subject with due restraint.

For the benefit of those who may not know him well, let me give you a short recap of his contributions to the science, art, and literature of our profession, particularly as they pertain to the criteria for the Award of Excellence.

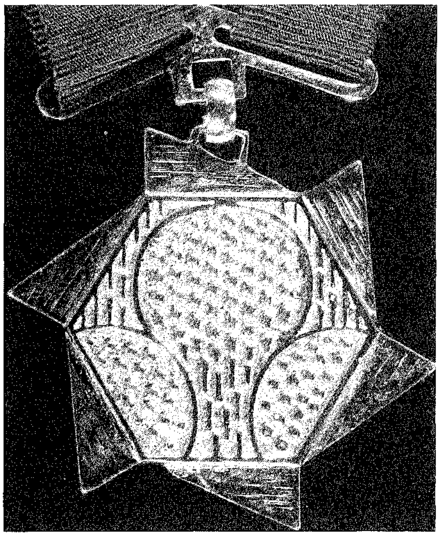
Dr Alexander Ian Hamilton, born and raised in Winnipeg, Manitoba, Canada, followed in his father's footsteps and entered the profession of dentistry. He graduated with honors from the University of Toronto in 1936 and practiced in Winnipeg for three years. He then decided to fight for "King and Country" in the second "war to end all wars," and enlisted in the Canadian Dental Corps in 1939. He married Mary Garrison in 1944. After a time in Canadian Dental Corps clinics, he served for four years in England and the Continent, attaining the rank of Major.

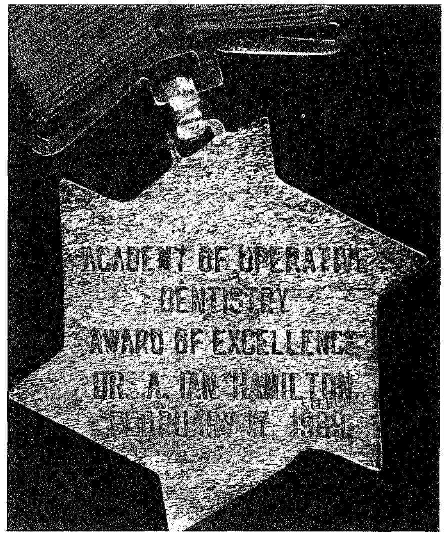
Upon return to civilian life, Dr Hamilton headed for British Columbia, and established a practice in the city of Victoria. In his zeal for self-improvement, he became a charter member of the Intercity Gold Foil Study Club of New Westminster. This necessitated travel from Vancouver Island to the mainland every month for clinical meetings.



A Ian Hamilton

After three years, he responded to a call to dental education and joined the faculty at the University of Washington School of Dentistry in 1949, as an Instructor in Operative Dentistry. In





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his 30 years at that institution, he rose to the rank of Professor of Restorative Dentistry, and Lecturer in Biological Structure in the School of Medicine.

In his early years at the University of Washington, besides full teaching duties, Dr Hamilton earned Bachelor's and Master's degrees in Economics; in the latter, his thesis was "An Economic Analysis of Dental Practice."

After 10 years, the lure of English education took Dr Hamilton to the University of London, on sabbatical leave for one year. There he came into inspirational contact with a number of eminent scientists, so after another year at the University of Washington, he returned to London to work for a PhD in Anatomy. To keep his hand in at dentistry, and with missionary zeal, he also held a post as Demonstrator in Oral Anatomy, and did his best to stimulate his English confreres to use gold foil. The graduate work took five years; Ian's thesis on oral mucous membrane involved studies early in the days of DNA research.

Back at the University of Washington, from 1968 to 1985, Ian engaged in research in dental implants, taught operative dentistry and occlusion and dental caries, served on the University Senate for two years, and resumed active participation in gold foil study clubs.

His major contribution to operative dentistry, I believe, was the period of 12 years when he served as Editor-in-Chief of *Operative Dentistry*, the organ of our Academy and that of the American Academy of Gold Foil Operators. During that period, he worked tirelessly to upgrade the quality of dental publications. His detailed attention to reviewing submitted manuscripts, and his stimulating editorials, earned widespread recognition and respect for the journal. His inborn love of the English language pushed and pulled the quality of the journal to an unusual level of excellence.

As a further notable contribution to our Academy, Dr Hamilton designed the logo which, with its outline of a bur and the microscopic view of enamel, symbolizes our objective of combining clinical dentistry with research. He also designed the Hollenback Prize, perpetuating the everlasting #3 Hollenback wax carver.

During his active years in dentistry, Dr Hamilton authored and co-authored some 24 papers; he contributed to several texts on operative dentistry, and wrote over 40 editorials for *Operative Dentistry*. He also presented over 75 papers and clinics on various topics.

Besides this, he kept busy in other dental organizations, serving as President of the American Academy of Gold Foil, the Associated Ferrier Study Clubs, the CAIC Seminar, and the

George Ellsperman Gold Foil Seminar. He holds memberships in the American Academy of Restorative Dentistry and the Anatomical Society of Great Britain and Ireland, and fellowships in the American College of Dentists, the International College of Dentists, and in OKU Honor Society.

Other honors that have come to Ian are the distinction of being named Outstanding Instructor of the Year by the University of Washington dental classes of 1959 and 1987, and receiving the student-requested designation as Commencement Speaker at the dental graduation ceremonies in 1986.

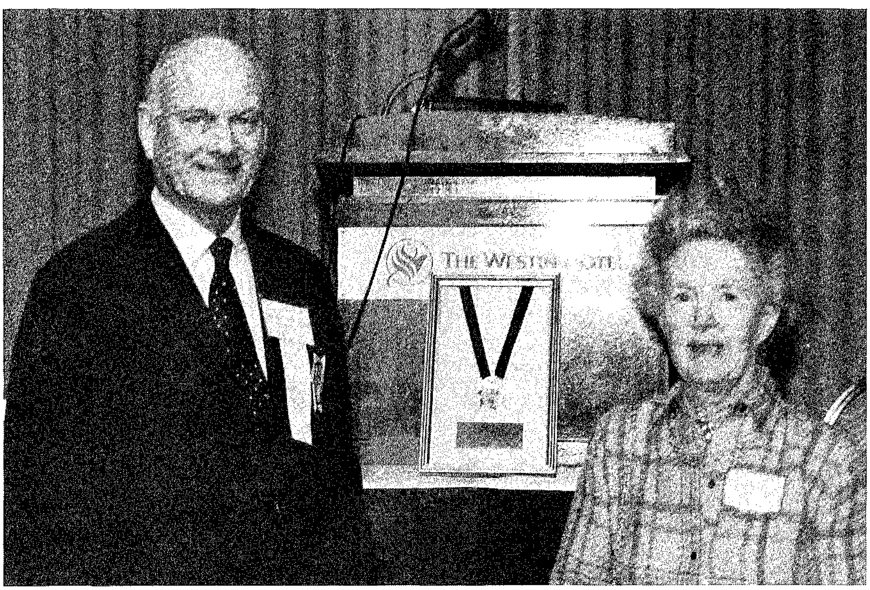
Our honoree retired from the University of Washington in 1985. However, that hardly ended his scholarly pursuits, for he is now enrolled as a freshman at the University of Washington, currently taking courses in algebra, introductory calculus, and English poetry. He continues membership in his gold foil study club and, in his spare time, is an avid house painter. (He specializes in painting soffets).

Ian is a most interesting person. He is extremely well read, and has a refreshing sense of humor. He has strong opinions about honesty and charlatanism in education, and about excellence in service, and also about English cars, necktie patterns, cats, Dixieland music, and classical literature. When it comes to beverages, he holds that "the best is none too good for the likes of us."

From this superficial view of Dr Hamilton, you will agree that he is an outstanding addition to the roll of recipients of this Academy's Award of Excellence. He more than meets the criteria for that honor. Ian, we thank you for your service and friendship. You are an inspiration to the members of our great profession. We extend sincere wishes to both you and Mary for continued happiness and good health.

We offer you a check to encourage you to stay in school a little longer, and a medallion that bears a replica of the logo you designed for the Academy, and which is inscribed on the reverse side, "Academy of Operative Dentistry, Award of Excellence, Dr A I Hamilton, February 17, 1989," to commemorate this special occasion. Congratulations!

GERALD D STIBBS, DDS, DMD



Ian and Mary Hamilton, Award of Excellence medallion in background

DEPARTMENTS

Press Digest

The editor wishes to thank the General Dentistry Residents, Class of 1989, Wilford Hall USAF Medical Center, for their assistance in the preparation of these abstracts.

A double-blind clinical trial to determine the importance of pumice prophylaxis on fissure sealant retention. *Donnan, M F & Ball, I A (1988) *British Dental Journal* 165 283-286.

(*Bristol and Weston Health Authority, 10 Marlborough St, Bristol, England, BS1 3NP)

This study compared 175 pairs of contralateral pit and fissure sites on 278 posterior teeth in 59 children. A randomly selected side of the mouth received a water-based flour of pumice prophylaxis prior to a 60-second etch, a 10-second wash, and a 10-second dry. The contralateral side received the same treatment but no pumice prophylaxis. All pits and fissures were sealed with Helioseal, a white, light-cured Bis GMA sealant and the retention for both groups was assessed at six and 12 months. There was no statistically significant difference in retention rates observed between the two groups.

Leakage of various types of alloys at the porcelain-metal interface. *Chambless, L A, Long, J L, Hembree, J H & Staffanou, R S (1988) *International Journal of Prosthodontics* 1(1) 47-50.

(*Department of Fixed Prosthodontics, Baylor College of Dentistry, 3302 Gaston Ave, Dallas, TX 75246)

This project evaluated the integrity of the porcelain-metal interface of six commercial casting alloys using radioactive isotopes. Isotope penetration was measured using autoradiographs at one, six and 12 months. All six alloys demonstrated isotope penetration at the interface. The high-gold alloys exhibited the best resistance to interface leakage followed by the palladium and then base metal alloys.

In vivo cusp fracture of endodontically treated premolars restored with MOD amalgam or MOD resin fillings. *Hansen, E K (1988) *Dental Materials* 4 169-173.

(*Helsingorsgade 7, DK-3400, Hillerod, Denmark)

In this study teeth were either restored with an MOD amalgam restoration or an enamel-bonded MOD resin restoration after endodontic therapy. Nearly one-third of the amalgam-restored teeth fractured during the 3-10-year interval. No resin restored teeth fractured during the same interval. In the following 3-10-year interval, fracture occurred with nearly equal frequency for both the restorative materials. Enamel-bonded resin restorations may be preferred to amalgam for the temporary restoration of endodontically treated premolars with MOD restorations.

Finishing glass polyalkenoate (glass ionomer) cements. *Woolford, M J (1988) *British Dental Journal* 165 395.

(*Department of Conservative Dentistry, The University, Dundee, England DD1 4HN)

This study reports on the surface examination of glass-ionomer cements under the scanning electron microscope, following the use of the most commonly recommended finishing techniques. The results show that the ideal surface was produced by the matrix. Soflex discs with vaseline produced a surface which was smooth and free from coarse grooves. White stones with vaseline tended to leave coarse grooves, but could be used in areas inaccessible to discs. Scalpel blades produced a marginal gap and were, therefore, not recommended.

Cuspal reinforcement in primary teeth: an in vitro comparison of three restorative materials. *Donly, K J, Wild, T & Jensen, M E (1988) *Pediatric Dentistry* 10(2) 102-104.

(*The University of Texas Health Science Center, Dental Branch, Department of Pediatric Dentistry, 6516 John Freeman Ave, Houston, TX 77030)

Twelve primary second molars were evaluated using a repeated-measures protocol for cuspal deflection stress following restoration of MOD preparations with either a composite resin (P-30), amalgam, or glass-ionomer (Ketac Silver) restorative material. Ranking the materials for support of cuspal strength, the composite resin was best with glass ionomer next and then amalgam. These results are consistent with those reported for permanent teeth.

A comparison of amalgam microleakage between a copal varnish and two resin-compatible cavity varnishes. *Kelsey, W P & Panneton, M J (1988) *Quintessence International* 19 895-898.

(*Creighton University School of Dentistry, 2500 California St, Omaha, NE 68178)

Two new cavity lining agents designed for use beneath composite resin restorations were tested for microleakage around an amalgam restoration with the hope of designating them as universal liners. While both of the new liners, Barrier and Cavi-Line, reduced microleakage better than no varnish, neither was as effective as copalite in reducing microleakage under a Dispersalloy amalgam.

Bonding of a composite restorative material to etched glass ionomer cement. *Wexler, G & Beech, D R (1988) *Australian Dental Journal* 33(4) 313-318.

(*Australian Dental Standards Laboratory, 240 Langridge St, Abbotsford, Victoria, 3067)

A composite restorative material (Silar) was bonded to various glass-ionomer cements that had been etched with 37% phosphoric acid. Tensile bond strengths were then determined. Results indicated that a mature cement surface, isolated from moisture during setting, yielded the greatest bond strengths (3.8 - 5.7 MPa). Increasing the cement film thickness from 0.15 mm to 0.45 mm doubled the bond strength. Fracture occurred in the surface layer of the glass ionomer and was dependent on the maturity of the cement.

Compatibility of accessory gutta-percha cones used with two types of spreaders. Jerome, C E, *Hicks, M L & Pelleu, G B (1988) *Journal of Endodontics* 14 428-434.

(*Naval Dental School, NDCNMCNCR, Bethesda, MD 20814-5077)

This study compared the apical seal produced by four combinations of spreaders and accessory points. A #30 finger spreader was used to condense either fine-fine or #25 gutta-percha cones for two groups. A D11-T spreader condensed either fine-fine or #25 gutta-percha cones for a total of four groups. Fifteen single rooted teeth were in each group. Canals obturated with a #30 finger spreader and #25 gutta-percha were more homogeneous. No significant differences in apical leakage between the four groups was noted.

Bonding Class II composite to etched glass ionomer cement. *Causton, C, Sefton, J & Williams, A (1987) *British Dental Journal* 163 321-324.

(*The Biomaterials Laboratory, King's College School of Medicine and Dentistry, Denmark Hill, London, England SE5)

This article evaluated etching times, etching materials, and the appropriate etching time for Ketac-Chem and Ketac-Silver. Comparing 30- and 60-second etch times, the 30-second etch was all that was required for an adequate bond strength of the glass ionomer to Occlusin. A 50% citric acid solution yielded bond strengths too weak to measure. Bond strengths with phosphoric acid surfaces were enhanced with the use of an intermediate, unfilled resin layer and the bond strength of Ketac-Chem was less affected by maturation in comparison to the Ketac-Silver in spite of the latter's more rapid setting time.

Book Reviews

ENDODONTOLOGY
Biologic Considerations in Endodontic Procedures
Second Edition

Samuel Seltzer, with the assistance of Paul Krasner

Published by Lea & Febiger, Philadelphia, 1988.566 pages, indexed, 431 illustrations. $59.50.

Seltzer's text is aptly titled. If "endodontics" texts stress procedures, then "endontology" texts emphasize reasons and consequences. The preface to the first edition states, "The (book) was written with a view toward establishing a biologic basis for endodontic therapy." The author further states that knowledge of the effects of diseases and endodontic procedures "is necessary for an understanding of the rationale for endodontic therapy." Assuming these quotations represent what Seltzer wishes to accomplish, his goals are achieved with extreme effectiveness. Each section (topic heading) reads easily and logically from biologic description to clinical implication. Most aspects of the specialty are examined in depth and each chapter is carefully and extensively referenced. There are many clear, high-quality, black-and-white photographs with an emphasis on normal and pathologic histology. A few well-chosen color plates would have improved the presentation of the book and would have broken the monotony of so many black-and-white photographs and the printed text. This is stated with the understanding that color adds markedly to a book's price.

There are a number of differences between the first and second editions. The second has more pages and is set in a larger type face. The text is reorganized to some degree but basically follows the same format. The reorganization is not always an improvement. For example, the reader must constantly turn between the chapters on filling materials (Chapter 9) and root canal fillings (Chapter 11) to maintain continuity. The subtopics listed in the first edition's table of contents are sorely missed in the second, and the index is a little scanty. Many of the same plates are used, but a good number of scanning electron micrographs are added. There are little or no wording changes in whole sections. This latter point is not a criticism as basic principles do not necessarily change even when new techniques and materials are introduced. Modern techniques and materials are included, such as sonic and ultrasonic instrumentation, lasers, thermoplastic gutta percha filling techniques, and plastic endodontic restoratives. The implant and pain sections are expanded and the microbiology chapter almost completely rewritten. There is an outstanding chart on page 162 describing each tooth's most common site of periapical exudate localization; however, the canal morphology classification depicted on page 20 appears overly complex compared to other systems in the literature.

From the operative dentist's point of view, Seltzer's text appears specifically aimed at an endodontist's concerns. There is little on the pulpal response to operative procedures and materials or restoration of the endodontically treated tooth. The occlusion section is outdated and there is almost no mention of endodontic access or chamber morphology. Endodontic procedural technique is not the emphasis of this book. If the reader desires information on step-by-step procedures to follow in the operatory, an endodontics text is probably more practical, but if studying for a board examination, *Endodontology* would be extremely valuable.

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AIDS: A GUIDE FOR DENTAL PRACTICE

Charles E Barr, DDS, and Michael Z Marder, DDS

Published by Quintessence Publishing Co, Inc, Chicago, 1987. 128 pages, indexed. 107 illustrations. $34.00.

This is the authors' first text on the topic of AIDS and its oral manifestations, although they have published scientific studies on AIDS and related infectious diseases. The content is divided into eight well-condensed chapters and an excellent introduction with a brief section on terminology. The chapters themselves follow customary topics frequently seen in other texts concerning infectious diseases including epidemiology, etiology, oral manifestations, clinical manifestations of associated disorders, and the treatment of patients with AIDS. Additionally, other important topics are covered in two other chapters: AIDS control in the dental office, and ethical/legal responsibilities of the dentist. A chapter is also devoted to the immunology of AIDS.

The book is well-organized and concisely written with a clear understanding of the primary care dentist's grasp of scientific knowledge. The material is current and includes recent changes in the classification of Human Immunodeficiency Virus (HIV) disorders. The chapter on epidemiology contains excellent color graphs that demonstrate changes in the pattern of the disease and tables that identify issues such as routes of infection. The discussion on etiology is directed toward the dental community with a section on HIV in saliva and its lack of potential spread by salivary contamination. A very clear and effective description of the process of immunity and how cells are infected by HIV occurs in Chapter Three with excellent graphic illustrations of the cellular processes involved.

Additional highlights of the book are the descriptions of oral and general manifestations of HIV and its related diseases. Many excellent color photographs of oral and skin lesions are provided. They demonstrate virtually every important clinical manifestation of AIDS in vivid color not often seen in texts of this size.

Dental practitioners will find the sections discussing office procedures and ethical issues valuable and provocative. A useful outline of operatory asepsis is included and should guide the concerned clinician through these sometimes emotional topics. Personal protection and use of sterile coverings of dental equipment is illustrated and suggestions offered for modifying the medical history to identify high-risk patients.

The book is written well and is of greatest value to the general dentist who wishes to gain considerable basic and clinical knowledge of AIDS. The discussions concerning etiology and immunology have been condensed to include only material of general interest. The text is also suited for dental students and those in dental hygiene programs. After reading the material and viewing the excellent illustrations and photographs, readers should find themselves equipped to recognize and manage patients with AIDS-associated lesions.

The authors are well-trained and have extensive clinical experience in the clinical management of HIV-infected patients. The focus in this book is on common problems frequently encountered in patients with AIDS, not on special clinics or those with extensive prior experience with HIV infections; this focus is not a disadvantage. The one area of the book which should be read with caution is the section which relates to the use of questionnaires to identify high-risk patients. In some states and cities such questions may violate legal statutes unless clear reason for such an approach is evident and supportable. Readers should consult their local health department or association to determine whether the proposed approach must be modified. Aside from that one caution the text is excellent in all respects and should be of value to all concerned dental practitioners.

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MASTERING THE ART OF COMPLETE DENTURES

Halperin/Graser/Rogoff/Plekavich

Published by Quintessence Publishing Co, Inc, 1988. 168 pages, 231 illustrations. $64.00.

Mastering the Art of Complete Dentures is the first text to be published in the 1980s describing the clinical and laboratory techniques of complete-denture construction. The text gives a step-by-step approach to complete-denture fabrication and is intended as a guide for the general dentist when treating the edentulous patient. Chapter 14 gives a brief description of the principles of partial-denture construction. The book contains personal references and thoughts from

Dr Allan Brewer, the mentor of the authors of the text.

The text is easy to read and understand and is a good review for any person who is actively treating complete-denture patients. The illustrations are nicely done, clear, and appropriate for the text. One can always argue with a particular technique that is described, but that is not the purpose of the text. The authors are not trying to convince the reader that a particular technique is best, but are giving a step-by-step approach to denture fabrication that has worked well for them. It would be impossible to describe in any text the myriad of techniques taught in dental schools in the United States.

The only criticisms of the text are that some of the illustrations would have been more appropriate if the dentist had been wearing gloves during patient treatment, and trying to summarize partial-denture design in one chapter is difficult, if not impossible. Perhaps expanding some of the later chapters of complete-denture fabrication and omitting the chapter on partial-denture fabrication would have been a more effective approach. *Mastering the Art of Complete Dentures* would be of benefit to general practitioners who are interested in having removable prosthodontics as part of their practice.

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DENTAL CARE FOR THE ELDERLY

Bertram Cohen, DDS, FDS, FRC and Hamish Thomson, HDD, FDS

Published by Year Book Medical Publishers, Inc, Chicago, 1986. 213 pages, 35 illustrations, 12 tables, $27.00.

All aspects of our society are being dramatically influenced by the expanding elderly population. The dental profession has only recently recognized the special dental needs of this group. This text presents a concise overview of the necessity for understanding the physical and psychological changes in the elderly and the difficulties of providing appropriate dental treatment.

The text is the combined effort of eight authors and is divided into two sections. The first four chapters deal with understanding the patient and the effects of the aging process as it relates to dental treatment.

Chapter 1 deals with the interaction of the dentist and elderly patient with special emphasis on communication and the special empathy, patience, and listening required on the part of the clinician. Chapters 2 and 3 review the physiological changes of the oral structures associated with aging, including a good discussion of common diseases of the oral mucosa.

The nutritional and metabolic considerations related to the elderly are discussed in detail in Chapter 4. The authors review the factors influencing nutritional status and provide numerous tables defining specific intake requirements. Guidelines for the diagnosis of subnutrition include clinical and physical signs available to the clinician.

The second half of the text discusses problems more related to the delivery of dental care both in the normal clinical environment and during visits to the patient's home. The authors provide numerous suggestions and equipment lists necessary for providing care at the patient's residence.

The last two chapters deal with special considerations related to restorative dentistry treatment-planning both for single-unit restorations (Chapter 6) and replacement of missing teeth (Chapter 7). The indications and technique for glass-ionomer restorations are emphasized for restoration of cervical lesions, while some unique partial-denture concepts for the restoration of the partially edentulous mouth are briefly described.

Throughout the entire text the authors emphasize patience, a caring attitude, and the ability to listen as the prerequisites for providing a quality dental program for the elderly patient. Although this text does not provide the depth needed in a reference text on gerodontics, it serves very well as an introduction to the subject and would be useful to the general dentist as well as the dental student.

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PORCELAIN LAMINATE VENEERS

David A Garber, DMD, BDS, Ronald E Goldstein, DDS, Ronald A Feinman, DMD

Published by Quintessence Publishing Co, Inc, 1988. 136 pages, 191 illustrations. $58.00.

This book provides a concise description of clinical and laboratory procedures of porcelain veneers. Color photographs beautifully illustrate clinical cases step by step. The "Atlases of Enamel Reduction and Laminate Placement" are handy and helpful for brief reviewing. A brief but thorough section covers laboratory procedures involved in both the refractory and platinum-foil techniques. The Dicor and Cerapearl cast porcelain systems and cases of resin-bonded bridges are also reviewed with color photos.

Dentists who wish to incorporate porcelain laminate veneers into their practice will find this book especially helpful.

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Letters

CLINICAL RESTORATIVE MATERIALS AND TECHNIQUES

In the Autumn 1988 issue of *Operative Dentistry*, our textbook, *Clinical Restorative Materials and Techniques*, published by Lea & Febiger of Philadelphia, was reviewed by Dr Ronald K Harris of Indiana University School of Dentistry. While certain aspects of his review or critique were quite constructive, a number of them borderlined on the absurd.

Certainly no textbook written is free of error. It is only appropriate that a textbook written for students and the profession be reviewed and critiqued. Such information is important to those who have developed the book. Hopefully they can use the comments to improve the text at the next possible opportunity.

Every textbook published by researchers and/or teachers undoubtedly possesses positive as well as negative aspects. Unfortunately, however, the review of our text made every effort to emphasize the negative without making any attempt to identify its attributes.

The reviewer, for example, stated that the scanning electron micrographs used as figures were not particularly new. Furthermore, he stated that they were combined with arbitrarily developed graphs and line drawings. On the contrary, the scanning electron micrographs were of excellent quality and related to an understanding of the textbook in a most pertinent manner. Regarding the graphs and line drawings, an example certainly would have been in order.

The reviewer stated that the scanning electron micrographs were not particularly new. First of all, when does an SEM become old? Furthermore, why would any older SEM detract from the quality of the textbook? Also related to this subject, it was suggested that all of the SEMs should have been at the same magnification. Obviously such a condition would not be appropriate since many of the component phases depicted with SEM were considerably different in size. Consequently, it would be absolutely meaningless to illustrate each item at the same magnification.

Finally, the reviewer commented that there was little or no discussion regarding evidence of necrosis due to the use of direct gold. Perhaps this one comment best underscores the reviewer's effort to point out the negative.

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ADVERTISING OF DENTAL PRODUCTS: In Whose Interest?

It is evident from your recent editorial, "Advertising of Dental Products," that misunderstanding and misinformation about the role of the American Dental Association in advertising review exists. Let me try to clarify.

The ADA has two scientific councils that have product review programs. The Council on Dental Therapeutics awards its Seal of Acceptance to products with documented therapeutic benefit that are safe and effective for their intended use. The Council on Dental Materials, Instruments, and Equipment has three separate evaluation programs. The Seal of Certification is awarded for products that have been certified as meeting specific standards or specifications; the Seal of Acceptance recognizes safety and usefulness as established by biological, laboratory, and/or clinical evaluations; and the Seal of Recognition is used for other products evaluated by the Council and shown to be safe and effective for the purposes intended. Currently, over 1,600 products carry one of the ADA Seals.

When an ADA Seal is awarded to a product, one of the required conditions for its use is that all advertising and product promotion must be reviewed and approved by the appropriate ADA Council. This applies to all consumer advertising, publications, direct mail promotions, dental exhibits and displays, etc, that appear in any ADA publications. Contrary to your editorial claim, it is indeed true that the scientific councils regulate the advertising claims made by the manufacturers. Dentists and consumers alike can be assured that the advertising for any product carrying the ADA Seal has undergone thorough scrutiny and approval.

In addition, advertising review and approval is required of any dental product advertising in an ADA publication, even if that product does not have a Seal. A panel comprising scientific, editorial, dental, legal and communications expertise reviews all such advertising to assure that it adheres to ADA advertising standards and is not false or misleading.

Rather than create a new council that would duplicate existing activities, I believe we need to create a better understanding among the profession of the significance of the ADA Seals and Association policy on advertising review.

I hope that *Operative Dentistry* and other dental publications will join us in that effort.

ENID A NEIDLE, PhD
Assistant Executive Director
Division of Scientific Affairs
American Dental Association
211 East Chicago Avenue
Chicago, IL 60611-2678

I read with some interest your editorial in the most recent issue of *Operative Dentistry*. You indicated that advertisements in the *Journal of the American Dental Association* are not reviewed for accuracy and that the Council on Dental Materials, Instruments, and Equipment does not regulate the advertising claims made by manufacturers. Needless to say this is not correct. All advertisements in ADA publications must comply with the advertising standards of the Association (see enclosed) so that they are factual and provide useful and accurate information for the dentist. In addition, as part of its evaluation programs the Council on Dental Materials, Instruments, and Equipment requires that all advertising for ADA-accepted, -certified, or professionally recognized products be reviewed by the Council before use. Therefore, your request for the establishment of a new Council on Advertising of Dental Materials and Devices appears to be unwarranted since advertising review is already occurring, at least at the American Dental Association.

WAYNE T WOZNIAK, PhD
Assistant Secretary
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Instruments, and Equipment
American Dental Association
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Chicago, IL 60611-2678

RESPONSE

I must certainly agree with Drs Neidle and Wozniak that there is a great deal of misunderstanding regarding the active role the ADA takes in monitoring advertising and that many dentists do not really understand the ADA Seal and what a product has to go through to get the Seal, but that is not the real issue. The real problem is: Is the stated review of dental advertisements enough to provide the dentist with what he/she needs to make a valid decision concerning what product to purchase? Their efforts to try to clear up the misunderstanding of what part the ADA plays in advertising is certainly valid, and I feel the two letters above will help to get that word out.

According to Drs Neidle and Wozniak, all advertising is monitored and,therefore, it is truthful and the practicing dentist can rely on it for making a valid judgment as to which product to purchase. If this were so, then there would have been no need for me to write the editorial. I will cite one example to demonstrate the point. The first page of the March issue of the *JADA* has an advertisement which I feel to be, at the minimum, untrue and misleading and perhaps even false advertising.

That advertisement is for a newly-marketed dentin bonding agent. Of course the manufacturer alludes to its superior bond strength as depicted in a bar graph taken from some of the data shown by Dr Barkmeier at the Annual Meeting of the Academy of Operative Dentistry, February, 1988. The graph vividly depicts the product mentioned as having a very high bond strength. So far so good, but I wonder how many dentists can look at that graph and know that the data presented in the graph was only a small part of the data shown by Dr Barkmeier and that this newly-introduced bonding agent was not part of that study and probably had not been developed at that time. Instead the manufacturer used data from one of their previous products which had a similar name. I ask Drs Neidle and Wozniak if that is really ethical advertising and, secondly, in whose interest is it?

The example cited above is only one, but I feel it is adequate evidence of the need for a change in the ADA's manner of addressing advertising. I rest my case!

DAVID J BALES, DDS, MSD
Editor

MORE ON: ADVERTISING OF DENTAL PRODUCTS: In Whose Interest

I have just received my Winter Edition 1989 of *Operative Dentistry* and I write immediately to applaud your editorial. I, too, have become increasingly dismayed in recent years by the apparent lack of responsibility demonstrated by certain manufacturers in their advertising of their products to the profession.

I realize full well that the exponential growth of knowledge has put the manufacturers under pressure to market the latest and the best as soon as they possibly can. However, I really believe that some of them are forgetting that they also have a responsibility to our patients, even though that responsibility is somewhat secondhand through us as operators.

I seem to recall that in years gone by there was a considerable amount of clinical research conducted into a new material before it was released to the profession. One felt a reasonable degree of reliance could be placed upon the veracity of the advertisements. A study of the literature was still, of course, desirable and a degree of caution was called for before making a change.

Now it seems that many manufacturers rely upon the profession to conduct their field studies, and their claims get more rash every day. There appears to be a tendency to play "fast and loose" with the truth, and along with the failure of follow-up sales, a product is either altered without notification or withdrawn.

Current favored terminology is utilized with scant respect for the truth and it seems to me that with the plethora of glossy brochures it is far more difficult to select a dental material of choice than it is to select a motor car.

The classic example recently in my particular area of interest is the careless use of the term "glass ionomer." The true glass ionomer requires the presence of a high fluoride ionomer glass with polyacrylic acid. It is then possible to achieve chelation with enamel and dentine to prevent microleakage along with a fluoride release over a long period of time. The inclusion of an ionomer glass in a light-activated resin does not constitute a glass-ionomer cement, and advertising it under that heading in my view is immoral.

I realize full well the problems that would be encountered by a Council on Advertising of Dental Materials and Devices and I do not envy their task. It seems a great pity to have to create yet another regulating body in our thoroughly over-regulated world. One would hope that manufacturers and advertisers could just stick with the truth.

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Announcements

The American Board of Operative Dentistry

The American Academy of Operative Dentistry held its annual meeting on 15 February 1989 and celebrated the awarding of certification documents to three new members: Dr Craig Bridgeman of Boone, North Carolina; Dr Maxwell Anderson of Bethesda, Maryland; Dr Joel Wagoner of Beckley, West Virginia.

Drs Bridgeman and Wagoner are in private dental practice, and Dr Anderson works and teaches at the Naval Dental Clinic in Bethesda, Maryland. They represent the most recent in a group of 17 dentists throughout the world who have been so honored by the American Board.

Board Certification is a form of recognition in dentistry for distinction as accomplished by successfully passing a three-part examination in Restorative Dentistry. Over a period of three or more years the candidate takes a written examination, an oral examination on completed clinical cases, and a two-day clinical examination.The certification system was established by the American Academy of Operative Dentistry in 1981, to promote the pursuit of excellence in dentistry in practice, education, and research in operative dentistry. As of this time, well over 30 dentists from around the world have begun the certification process.

For information please contact:

ROBERT C KEENE, DMD
31 South Park Street
Hanover, NH 03755(603) 643-4142

Newly certified members of ABOD - - (left to right) Drs Joel Wagoner, Maxwell Anderson, and R Craig Bridgeman.

Academy of Operative Dentistry

The eighteenth annual meeting of the Academy of Operative Dentistry was held 16 and 17 February in Chicago at the Westin Hotel. An excellent program comprised of meetings, essays and table clinics was presented. The eighth annual Buonocore Memorial Lecuture was delivered by Edwina Kidd of London, England. At lunch on the first day the Hollenback Memorial Prize was presented to Gerald T Charbeneau. A Ian Hamilton was presented the Award of Excellence at the luncheon on the second day.

Officers elected for 1989 are: president, Anna T Hample; immediate past president, J Martin Anderson; president-elect, R Craig Bridgeman; vice president, José Medina; secretary-treasurer, Ralph J Werner; and assistant secretary, Gregory E Smith. Councillors for 1989 are Charles F Morris and Daniel C T Macintosh; for 1990, Thomas G Berry and Joel Morris Wagoner and for 1991, Joseph B Dennison and Warren K Johnson. Seventy-seven new members were voted in this year.

NOTICE OF MEETINGS

American Academy of Gold Foil Operators

Annual Meeting:
1-3 November 1989
University of Washington
Seattle, Washington

Academy of Operative Dentistry

Annual Meeting:
8-9 February 1990
Westin Hotel
Chicago, Illinois

ACADEMY OF OPERATIVE DENTISTRY
1990 Table Clinics

Anyone interested in presenting a Table Clinic at the 8-9 February 1990 meeting of the Academy of Operative Dentistry should request an application form from:

José E Medina, Vice-President
5002 NW 18th Place
Gainesville, FL 32605

Deadline for receipt of completed application is 30 May 1989. Selection will be based on the needs of the program and date of receipt of application.

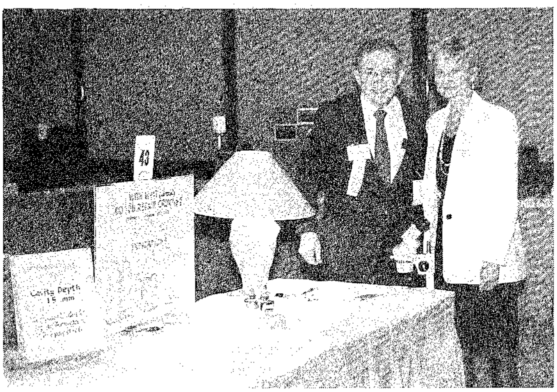
Scenes from the AOD Meeting

Dr Norman presents certificate of appreciation to Dr Kidd for the Buonocore Memorial Lecture.

J Martin Anderson, Academy president, 1988-89

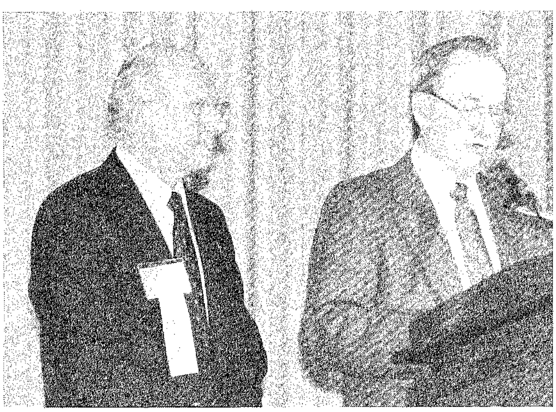
Gerald Stibbs congratulates Ian Hamilton on the Award of Excellence

Council members and officers are installed



Lloyd Baum and Sarah Werner ready to present their table clinic

Paul Loflin describes the objective of the Founders Fund to Academy members.



Richard Norman reads citation for the Hollenback Prize to Gerald T Charbeneau.

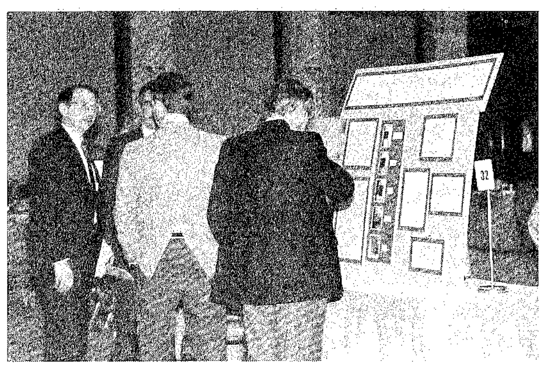


Table clinics always generate a lot of discussion.

In Memoriam

Our profession and members of the Academy of Operative Dentistry and the Academy of Gold Foil Operators lost a dear friend and colleague with the passing of Dr Robert B Bridgeman at his home in New Martinsville, West Virginia, on 13 March 1989, following an illness.

He was born 28 April 1928 in New Martinsville, the son of Dr George and Georgia Long Bridgeman.

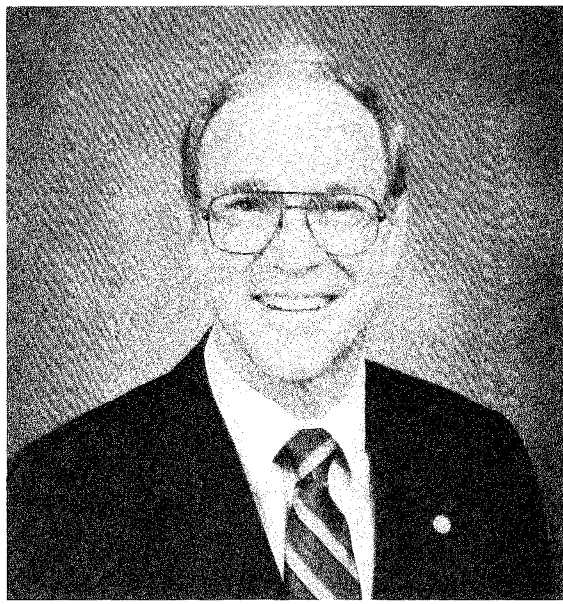
Bob graduated from the Baltimore College of Dental Surgery in 1983. Following a tour in the US Army Dental Corps, he established his private practice in New Martinsville, where he was active in the profession for the past 34 years.

Dr Bridgeman was a charter member of the Academy of Operative Dentistry, a founding member of the American Board of Operative Dentistry, and held membership in the George M Hollenback Operative Dentistry Seminar, American Academy of Gold Foil Operators, International College of Dentists, American College of Dentists, the Pierre Fauchard Academy, and Omicron Kappa Upsilon. He was also an active member of the American Dental Association and the West Virginia State Dental Association, serving as its president in 1983-84.

He was a member of the West Virginia State Board of Dental Examiners for 10 years, serving as its president from 1983-84, and was also a member of the Northeast Regional Board of Dental Examiners since 1974.

An active member of his community, Dr Bridgeman was past president of the Wetzel County Hospital Board of Trustees and the New Martinsville Rotary Club and a member of First Christian Church of New Martinsville.

His wife, Marjorie Emerick Bridgeman, preceded him in death in 1980. Surviving him are: three sons, Dr R Craig of Boone, NC; Dr David F of New Martinsville; and John B of Bethel Park, PA; a daughter, Dr Laura J Bridgeman, stationed with the U S Army in West Germany; and five grandchildren. David, Craig, and Laura are practicing dentists. John B graduated from the US Naval Academy, has BS and MS degrees in mechanical engineering, and is presently employed in private industry. Bob is also survived by three brothers: William E and John L, both of New Martinsville, and George A of Friendly, as well as a sister, Mary B Moore of Thousand Oaks, CA.



Robert B Bridgeman

Bob Bridgeman was a dedicated professional, dedicated to his family, community, church, and the profession he loved so well. He was loved and respected by all he encountered. He made an impact on his profession and the world we live in. He will be missed.

INSTRUCTIONS TO CONTRIBUTORS

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OPERATIVE DENTISTRY

SPRING 1989 • VOLUME 14 • NUMBER 2 • 57-112

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