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EDITORIAL

Information Transfer in a High-tech Society

Information concerning all aspects of our dental profession and of other professions has been exploding at an alarming rate. The number of dental journals has increased significantly in recent years just to keep up with the amount and types of papers requiring publication.

How can we keep current? Certainly not by reading textbooks which are already outdated by the time they are printed. Perusing several dental journals used to keep the dentist fairly well informed about changes going on and new materials being promoted; however, that is no longer adequate. The length of time from the completion of the research to the manuscript's eventual publication is frequently well over a year, and in some instances over two years. Many products in the field of dental materials and devices are either no longer on the market or have been modified by the time papers discussing them are published. This cannot be considered "keeping current."

To keep up with these changing times, the University of Washington School of Dentistry is embarking on a new adventure which we hope will allow for easier and more rapid dissemination of current information. It will also serve as a data base for anyone with a computer and a modem. We are establishing a dental bulletin board which we have named *Operatory 2000*.

We intend to have several types of memberships available to interested participants. The broad general access area of this program (at no fee) will allow users to enter a question about some problem or technique they would like answered. This message would be directed to everyone who also accesses the bulletin board system. With such a scenario, it would be generally expected that several individuals could provide answers. This would be a true sharing of collective experiences about clinical entities or new products, etc.

Also within the general access area, our Continuing Education Division will keep a posting of all its courses for the year and any relevant information for the dentist to read. It will also include the ability to register by computer for any course listed, and it will allow individuals to make suggestions about new programs in which they might be interested.

At another level is access to people within each department of the dental school (for which there would be a fee). Users can ask specific questions and expect an answer. Both the question and answer can be read by all subscribers at this level. Also within this same level of access will be a file section maintained by each specialty which will contain abstracts of current articles and abstracts of research recently completed at the institution and not yet published.

In the long run, it would seem wise for this institution to form a consortium with two or three other schools to establish a national bulletin board network. Presently we plan on offering this bulletin board to members of the profession at the annual meeting of the Washington State Dental Association. We feel that this system has the potential for great benefits and support for practicing dentists.

If you are still without a computer and modem, move forward and get them soon. If you have a computer now but not a modem, get one and give us a call. These are exciting times. Don't be left out!

DAVID J BALES
Editor

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ORIGINAL ARTICLES

Five-Year Clinical Assessment of 14 Amalgam Alloys

J W OSBORNE

Summary

A clinical assessment of the fracture at the margins of 547 restorations of 14 amalgam alloys indicated that there was a significant difference in the rate of fracture at the margin of the amalgam alloys after five years. Of these restorations, 12 were lost and the causes were bulk fracture of the restoration (four) and cusp fracture (eight).

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J W Osborne, DDS, MSD, professor and director of clinical research

Introduction

In spite of a negative image the past several years, amalgam remains the most widely used restorative material. Several problems are associated with amalgam, but fracture at the margins is the most common. This failure, although not one that necessarily requires replacement of the restoration, has been used as a research tool to evaluate the clinical performance of amalgam alloys (Mahler, Terkla & Van Eysden, 1973; Letzel & others, 1987) and various manipulative procedures (Leinfelder & others, 1978; Mayhew, Schmeltzer & Pierson, 1986; Letzel & others, 1989). Until recently, the concept that fracture at the margin predicted long-term clinical performance had not been verified. Recently, however, longer-term studies have demonstrated that early fracture at the margins predicts long-term success of the restoration (Letzel & others, 1989; Osborne & others, 1989a; 1989b.)

The purpose of this study is to report the five-year data on 14 commercial amalgam alloys.

Methods

Although the one- and three-year data have been reported (Osborne & Friedman, 1986; Osborne & others, 1986), a description of the study is presented here.

The alloys studied were Cluster, Contour, Cupralloy, Cupralloy ESP (two different batches tested), Dispersalloy (two different batches tested), Indiloy, Orosphere II, Premalloy, Summalloy, Sybraloy, Tytin (two different batches tested), Unison (two different batches tested), Velvalloy, and a high-copper blend manufactured by Syntex. In addition, laboratory data on creep were obtained. The alloys, manufacturers, batch numbers, pretrituration Hg contents, amalgamators, trituration times, and speed of amalgamators are listed in Table 1.

Originally 126 patients were treated. Each patient required a minimum of five restorations with opposing occlusion. Of the restorations placed, 82% were class 2 and the remainder were class 1. Approximately 50 restorations of each material were inserted by the author.

Each restored tooth for a given patient received a different material, and the selection of alloy was on a random basis. A rubber dam was used throughout the restorative procedure. Teeth were prepared in a conservative manner where possible. Life (Sybron/Kerr, Romulus, MI 48174), a calcium hydroxide preparation, was placed in deep preparations, and Copalite (H J Bosworth Co, Skokie, IL 60076) was applied to the cavity walls. All batches of alloys were manipulated according to the manufacturers' recommendations. All amalgams were condensed by hand and carved with sharp instruments using conventional technique. The restorations were neither burnished nor polished. At a postinsertion appointment all restorations were lightly finished with a #2 round finishing bur to remove tarnish.

The fracture at the margins of restorations was evaluated by black-and-white photographs made of each restoration with a 200 mm Medical Nikkor lens (Nikon, Inc, Garden City, NY 11530) at a magnification of X1.5. Prints were made on a 4 x 5-inch format yielding a picture approximately six times the original tooth size. The prints were cropped to show only the restored tooth with pertinent information such as name of patient, tooth number, alloy, and time period recorded on the back.

The photographs were evaluated by two methods. First the photographs were placed into six categories reflecting increasing amounts of fracture at the margins. The data were analyzed by ridit analysis as described by Mahler and others (1973). The second technique compared one brand of alloy to another by serially ranking each restoration (Osborne & others, 1976). This consisted of ranking each restoration from best to worst with the data analyzed by the Mann-Whitney U test. Two evaluators independently categorized and ranked each restoration.

Results

The ridit analysis of the categorized data and the rank ordering test are summarized in Table 2. Interpretation of the data indicates that Indiloy, Dispersalloy, the Syntex alloy, Cluster, and Unison had the least fracture at the margins. These alloys were closely followed by Premalloy, Tytin, and Cupralloy, with some overlap with the first group of alloys. The alloys Contour, Cupralloy ESP, and Sybraloy came next, and finally, Orosphere II, Velvalloy, and Summalloy had the highest rate of fracture at the margins.

A significant correlation was found between the one- and three-year data and that of the five-year data (0.91 and 0.93 respectively). The correlation between the mechanical property creep and fracture at the margins at five years was -0.16, which is not significant.

The ridit analysis and the rank ordering test were completed by two evaluators working independently and the reliability of the evaluations was assessed. For the ridit analysis, 84.2% of the photographs were categorized in the same group by the two evaluators and no photograph was more than one unit different. A Spearman rho analysis was calculated for the rank ordering test and found to be between 0.92 and 0.97 for the two evaluators. Both evaluations indicate high reliability in the evaluation procedure.

Discussion

The 14 alloys after five-year clinical service exhibit the same general order as was found at one and three years. The amount of fracture at the margins had increased, but those that were best at one year were best at five years. Additionally, different batches of the amalgam alloy were performing in a similar fashion.

Table 1. Comparative Data of Alloys Tested

Alloy	Manufacturer	Batch Number	Hg (%)	Trituration	
				Amalgamator	Time (Sec)
+Cluster	S S White Co, Holmdel, NJ 07733	5433-91-3	49.5	Capmaster	16
+Contour	Sybron/Kerr, Romulus, MI 48174	80 X	46.6	Adec (H-setting)	14
+Cupralloy	Syntex Dental Products, Inc Valley Forge, PA 19482	0038-936	50.0	Adec (M-setting)	10
+Cupralloy ESP	Syntex	0011-936	50.0	Adec (M-setting)	20
+Cupralloy ESP (2)	Syntex	EC010320	46.0	Adec (M-setting)	20
+Dispersalloy	Johnson & Johnson Dental Products Co, East Windsor, NJ 08520	OD822	50.0	Adec (M-setting)	15
+Dispersalloy (2)	Johnson & Johnson	1G832	49.6	Vari-Mix II (M-2 setting)	5
Indiloy	Shofu Dental Corp, Menlo Park, CA 94025	097608	45.0	Vari-Mix II (M-2 setting)	10
Orosphere II	Pentron Corp, Wallingford, CT 06492	-	42.5	Adec (H-setting)	10
+Premalloy	Premier Dental Products Co, Norristown, PA 19404	TW-25	50.0	Vari-Mix II (M-2 setting)	10
Summalloy	Shofu	158003	47.5	Adec (H-setting)	12
Sybraloy	Sybron/Kerr	1051	4501	Adec (H-setting)	14
+Tytin	S S White	575910	42.4	Adec (H-setting)	5
+Tytin (2)	S S White	4968112	42.5	Capmaster	5
+Unison	Johnson & Johnson	D 81149C	42.0	Vari-Mix II (M-2 setting)	6
+Unison (2)	Johnson & Johnson	39-567	42.0	Vari-Mix II (M-2 setting)	6
Velvalloy	S S White	-	50.0	Adec (M-setting)	13
+High-copper blend	Syntex	EC010352	50.0	Adec (M-setting)	10

Adec (M) 3000 cpm; Adec H 4300 cpm; Capmaster 3300 cpm; Vari-Mix II 4600 cpm (M-2)

+Precapsule alloy

(2) = Second batch tested

Table 2. Ridit Means, Rank Ordering, and Number of Restorations at Five Years

Number of Restorations	Alloy	Ridit Means	Rank Ordering*
32	Indiloy	.3436	|
33	Dispersalloy	.3462	|
31	Syntex	.3640	|
35	Cluster	.3713	|
31	Dispersalloy	.4146	|
29	Unison	.4348	|
30	Premalloy	.4613	|
30	Unison	.4744	|
33	Tytin	.5007	|
30	Cupralloy	.5049	|
32	Tytin	.5204	|
29	Contour	.5597	|
29	Cupralloy ESP	.5715	|
28	Sybraloy	.5789	|
30	Orosphere II	.6457	|
29	Cupralloy ESP	.6487	|
27	Velvalloy	.6494	|
29	Summalloy	.6605	|
547			

*$P < .05$

| = no significant difference

Studies (Berry & others, 1985; Letzel & others, 1989) have demonstrated that zinc in the alloy can reduce the fracture at the margins and increase the survivability of the restoration. In this study we get a similar result in that the best five alloys all contain zinc, whereas the other high-copper alloys contain little (<0.1%) or no zinc.

The loss rate of amalgam restorations in the study was 2.1% over the five years. Eight restorations were replaced due to fracture of the tooth and four were replaced due to bulk fracture of the amalgam. Only one bulk fracture occurred within the first six months and no fracture was evident in the six-month photographs of the four restorations that fractured at later times. None of the restorations were replaced due to recurrent caries, fracture at the margins, or tarnish. Due to the low rate of loss of amalgam restorations, no relationship could be determined between the alloy and failure. The low failure rate in this study is similar to the clinical data reported by Roberson and others (1989) at North Carolina.

This clinical data could assist dentists in choosing an amalgam alloy that will provide a better service to their patients. Obviously there are several factors that influence the dentist when choosing an amalgam alloy. These include ease of manipulation, convenience, and cost. But the ultimate should be the service provided to our patients.

Conclusions

Fracture at the margins of 14 dental amalgam alloys were evaluated after five years of clinical service. The results of evaluating 547 restorations indicate that Indiloy, Dispersalloy, a Syntex alloy, Cluster, and Unison had less fracture at the margins. The alloys Premalloy, Tytin, Cupralloy, Contour, Cupralloy ESP, and Sybraloy were in a middle group. The alloys Orosphere II, Velvalloy, and Summalloy exhibited the most fracture at the margins. The rank of the alloy from the first year through to the fifth year did not change significantly, and a nonsignificant correlation was found between creep and fracture at the margins. The replacement of restorations was very low at 2.1%, and the majority of replacements were caused by tooth-cusp fracture.

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Mercury Release from Amalgam: A Study in Vitro and in Vivo

R AHMAD • J G STANNARD

Summary

Total mercury release from a high-copper and a low-copper amalgam was measured in a study in vitro using atomic absorption spectrophotometry. Conditions of mechanical agitation and sealant coverage were evaluated over time. Mercury release was found under agitation and no-agitation conditions to increase shortly after preparation and then to level off after 24 to 48 hours. No difference in mercury release was observed for either amalgam type. Sealant coverage of amalgam significantly reduced mercury release under agitation conditions. In an experiment in vivo mercury vapor was measured at different times for patients receiving their first amalgam restoration. Sealant coverage was found to significantly reduce mercury vapor after chewing on this restoration compared to a nonsealant-covered amalgam.

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INTRODUCTION

In recent years, several studies have measured free mercury from dental amalgam. The potential effects of mercury and amalgam on both patients and personnel in the profession have raised serious questions about the use of amalgam. Studies in vivo have measured mercury levels in expired air (Svare & others, 1981; Reinhardt & others, 1983; Patterson, Weissberg & Dennison, 1985) and in blood (Abraham, Svare & Frank, 1984; Snapp & others, 1989) of subjects with amalgam restorations. Different studies, however, have failed to show an increase in mercury levels in saliva (Nilner, Akerman & Klinge,

1985) in relation to dental amalgam. Studies in vitro have determined different treatment effects on the amount of mercury release from amalgam. Variations in pH, time, and temperature have clearly shown an influence on release of mercury (Ahmad & Stannard, 1987; Okabe & others, 1987; Kozono & others, 1982; Brune, 1981; Ohta, 1983). Some drawbacks in these experiments, however, have been controlling test-sample weight, size, and shape, as well as variations in different test conditions. These problems are particularly apparent with studies in vivo where it becomes unrealistic to control all the variables contributing to release of mercury from dental amalgams.

The present study was conducted in two parts. Part 1 was a study in vitro which was undertaken to devise a method that would measure mercury from amalgam while controlling the variables of size, shape, weight, and test conditions. A goal of this study was to devise a clinically acceptable method to reduce mercury release from dental amalgam. The aims of the study in vitro were:

1) to measure the rate of mercury release from both a low-copper and a high-copper amalgam,

2) to evaluate the effect of a pit and fissure sealant to reduce mercury release from amalgam, and

3) to evaluate the effect of simulated abrasion on goals 1 and 2.

Part 2 of this study was a study in vivo to measure the effect of sealant coverage in limiting mercury release from dental amalgam.

METHODS AND MATERIALS

Study in vitro

SAMPLES FOR MEASURING MERCURY RELEASE

A low-copper amalgam, Velvalloy (S S White, Holmdel, NJ 07733), and a high-copper amalgam, Tytin (S S White), were used for this study. Amalgam samples were prepared according to ADA Specification No 1 to make uniform cylindrical specimens measuring 4 x 7 mm. Ten minutes after preparation, each sample was immersed individually in a sealed test tube containing 0.9% NaCl (Ace Surgical, Brockton, MA 02403), volume 9.5 ± 0.25 ml. For Tytin, test intervals for time release of one hour, two hours, three hours, one day, two days, three days, five days, six days, seven days, 10 days, and 14 days were studied. For Velvalloy, test intervals were one day, two days, three days, five days, six days, seven days, 10 days, and 14 days. Five specimens for each interval of both amalgam types were evaluated with simulated abrasion. Another group of each amalgam type was left without abrasion for the same time intervals to serve as controls.

SAMPLES FOR EVALUATION OF SIMULATED ABRASION

Cylindrical samples of Velvalloy and Tytin were made as described previously. After one hour of aging in air, the samples were weighed and dimensions of height and diameter measured with a micrometer. The samples were immersed in saline and mounted on a hematology/chemistry mixer (Fisher Scientific, Medford, MA 02155) that rotates 12 times per minute, for test intervals of one hour, two hours, 12 hours, one day, two days, five days, seven days, and 14 days. After completion of the test intervals, the solution was filtered and the amalgam sample and filter paper allowed to dry for 24 hours. Height and diameter were measured again and both paper and amalgam sample weighed. Weight changes were measured and converted to volume loss using the density of the amalgam.

SEALANT-COVERED SAMPLES

Additional Tytin amalgam samples were coated with a pit and fissure sealant (Delton Tinted, Johnson & Johnson Dental Products Co, East Windsor, NJ 08520). The sealant was mixed according to the manufacturer's instructions and applied to the amalgam sample with a sable brush. Sealant application was separately measured after polymerization using a microscope to determine the thickness on amalgam (Gwinnett & Smith, 1981). An average thickness of 83.6 ± 34.15 μm was applied to these samples.

Sealant-covered amalgam test groups were immersed in saline and also evaluated for

abrasion. Test intervals for these treatment groups were one day, two days, three days, five days, seven days, 10 days, and 14 days.

ANALYSIS FOR MERCURY

The mercury concentration in the test solutions was analyzed using an atomic absorption spectrophotometer (Buck Scientific, Norwalk, CT 06850). A calibration curve was prepared from solutions of mercury II chloride in distilled water to which stabilizing lanthanum nitrate was added.

At the end of each test interval, the amalgam sample was separated from the test solution. The solution was poured directly into a 25-ml volumetric flask. The test tube was washed twice with concentrated nitric acid to recover ions that may have been adsorbed on the glass walls. Each wash was added to the original solution in the volumetric flask and the total volume brought to 25 ml with concentrated nitric acid. Two hours were allowed to elapse before analysis. Each solution was stirred thoroughly and the test aliquot analysis taken directly from the flask. For all tests, five samples were tested for each time interval. All data were tested for statistical significance using the Mann-Whitney U test at $P = 0.05$.

Study in vivo

Sixteen subjects were chosen to participate. Selection was made by the following criteria: 1) no significant health risks or contraindication for dental treatment, 2) no existing dental amalgam restoration, and 3) need for at least one dental amalgam restoration involving the occlusal surface. The informed consent of all human subjects who participated in the experimental investigation reported in this manuscript was obtained after the nature of the procedure and possible discomfort and risks had been fully explained.

Subjects were divided into two groups: 1) Control Group: Eight subjects received a single dental amalgam restoration (Tytin) as per routine clinical procedure (range in age was five years, nine months, to 24 years, nine months; mean age was 12 years. 2) Experimental Group: Eight subjects received a single dental amalgam (Tytin) that was covered with sealant (Delton Tinted). Placement of amalgam and sealant followed routine clinical procedures and the manufacturer's instructions. The age range of this group was five years to 17 years, seven months; mean age was 9.5 years.

All patients were tested for oral mercury vapor levels and saliva mercury concentrations at different test intervals. The Jerome 511 Gold Film Mercury Analyzer (Jerome Instrument Corp, Jerome, AZ 86331) with a flow rate of 0.85 liters per minute was used for taking intraoral mercury vapor measurements. To measure mercury vapor in intraoral air, a collection tube was placed in the subject's mouth next to the tooth that was restored, and the subject instructed to breathe normally. The subject was not required to breathe in any specific manner as any sample population may contain habitual mouth breathers and should be taken into account. After a 60-second sample, the mercury vapor reading was recorded.

Analysis of mercury concentration in saliva was also performed after 10 minutes of chewing sugarless gum. Saliva was collected, measured for volume, and diluted with an equal amount of concentrated nitric acid. The saliva solution was analyzed for mercury content.

The study in vivo was conducted according to the following schedule:

Visit 1: After initial examination, each subject was screened for participation and parental/guardian consent obtained. Baseline measurement of intraoral vapor next to the tooth to be restored was taken. This was to familiarize the subject with the instrument and the procedure.

Visit 2: Subject presented for restorative procedure. For the control group, baseline mercury vapor measurements were taken before placement of the rubber dam. Another reading was taken after completion of the restoration and before the rubber dam was removed. Every effort was made to wash all amalgam debris from the rubber dam and the tooth before taking this reading. A third reading was taken after removing the rubber dam. For the experimenal group, the same measurements were taken except that a pit and fissure sealant was applied on the amalgam before the rubber dam was removed. Both treatment groups were asked to rinse thoroughly with water before the third measurement was taken. Subjects were not asked to chew

gum at this visit. Baseline saliva samples were collected before the restorative procedure and after taking the baseline vapor measurements.

Visit 3: Recall, one day after treatment. For both groups, mercury vapor measurements were taken before and after chewing vigorously on a piece of sugarless gum for 10 minutes. The subject was instructed to chew on that side of the mouth where the tooth was restored. Another saliva sample was taken after chewing gum for 10 minutes.

Visit 4: Recall after one week. The same procedure was followed as on visit 3. During this protocol the amalgam restorations were not polished.

RESULTS

Study in vitro

ABRASION TEST

Weight loss due to simulated abrasion is shown in Figure 1. Initially there was rapid material loss with statistically significant weight differences between one-hour, two-hour, and 12-hour time intervals. After that there were no significant differences between the 12-hour, one-day, and two-day samples. Weight loss at day seven and day 14 were not significantly different from each other but statistically they were higher than all earlier time intervals.

MERCURY RELEASE

Without agitation: Figure 2 shows total mercury release from Velvalloy and Tytin without agitation. For these samples mercury release increased within the first 24 hours and then stabilized over longer periods of time. For Velvalloy the only statistically significant difference in mercury release was that on day three it was lower than for all other groups. Measurements from Tytin at one hour, two hours, and three hours are shown in Figure 3. Mercury levels at one hour were significantly lower than at three hours. Although the mercury level at three hours was lower than at one day for Tytin, there was no significant difference when compared to time periods after day one.

With agitation: Results of mercury release from both Velvalloy and Tytin under conditions of

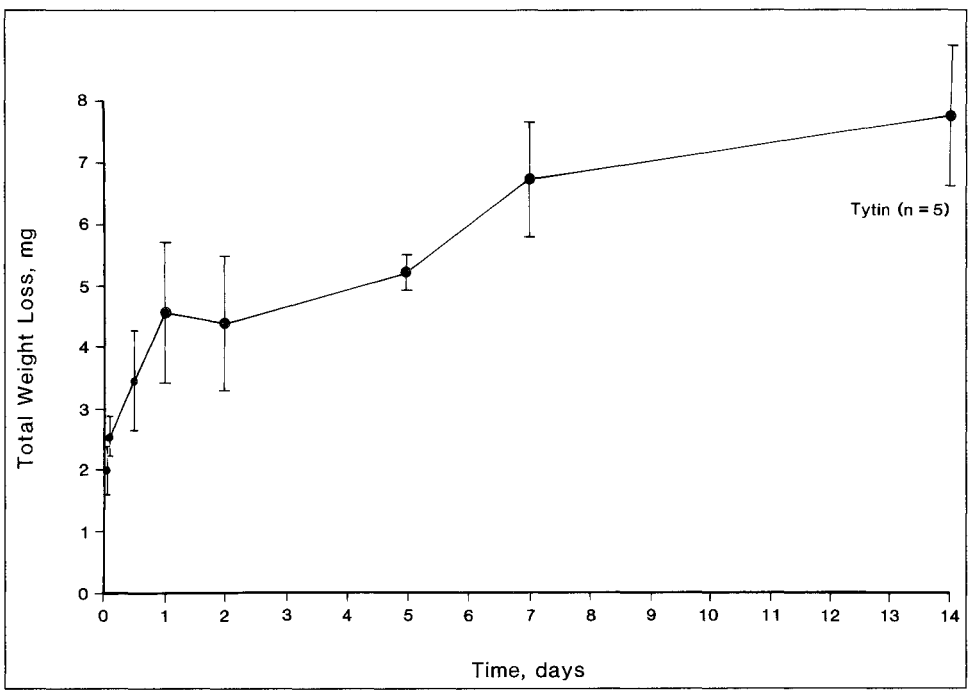

FIG 1. *Sample weight loss of Tytin from mechanical agitation over time*

agitation are presented in Figure 4 (a change in the scale of the Y-axis should be noted). Again a rapid increase in mercury release was observed within the first day for both amalgam types. Over longer periods of time mercury release again leveled off. Tytin samples of one hour, two hours, and three hours showed significantly lower mercury levels compared to longer time intervals for both Velvalloy and Tytin. As in the no-agitation group, the three-hour samples released significantly higher mercury than the one-hour samples, but lower than that for day one of the Tytin samples.

For both amalgam types the mercury levels measured for all agitation groups were significantly higher than the levels for the no-agitation groups; exceptions were the one-hour, two-hour, and three-hour agitation samples of Tytin. The highest mean value obtained for mercury in the no-agitation test was at day one for Velvalloy

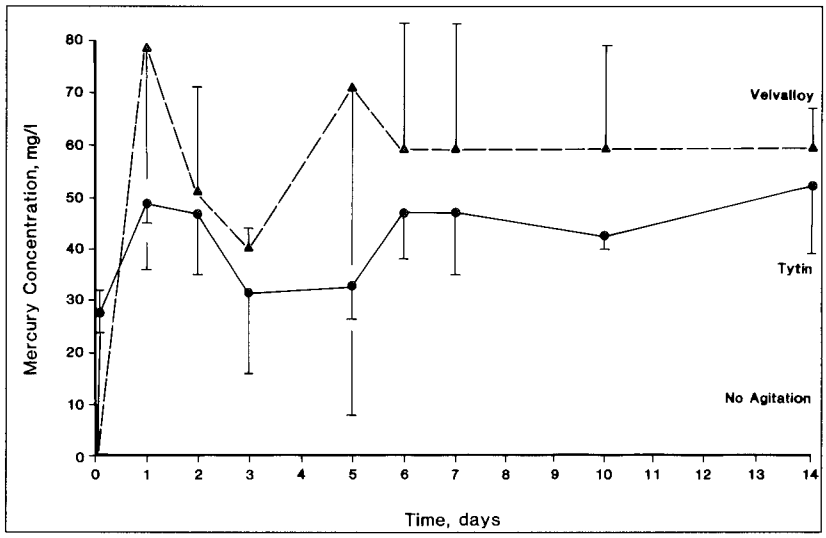

FIG 2. *Total mercury release from Velvalloy and Tytin over time with no agitation*

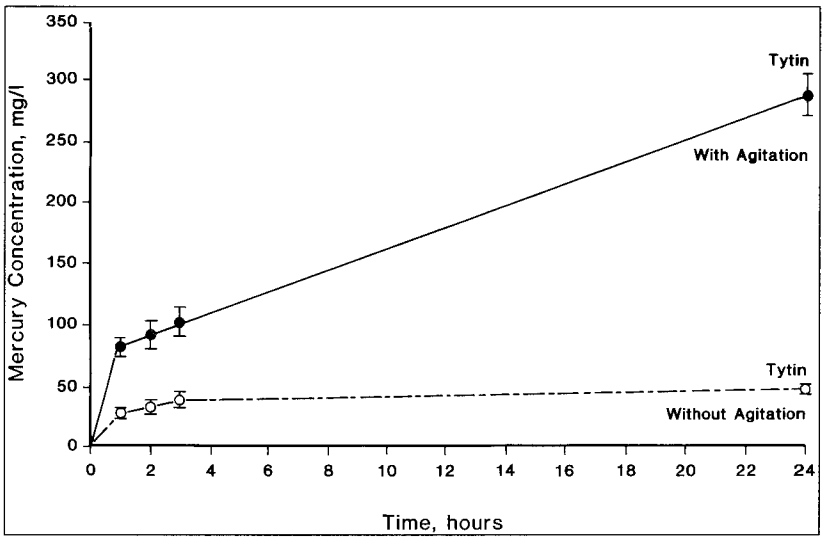

FIG 3. *Total mercury release from Tytin over short time intervals with and without agitation*

(79 ppm ± 43 ppm). For the agitation group, the highest mean value was shown by Tytin at day 14 (588 ppm ± 32 ppm).

When comparing the overall results for both amalgam types, no differences in mercury release patterns were observed for the low-copper amalgam, Velvalloy, or the high-copper amalgam, Tytin; however, individual time differences were observed between the materials.

Sealant-covered amalgam samples: Figure 5 shows mercury release from Tytin samples that were coated with sealant. Under conditions of agitation, the sealant-coated amalgam showed significant reduction (Fig 5) in mercury release compared to the untreated amalgam. The maximum mean concentration of mercury for the sealant group was 53 ppm ± 20 ppm, whereas without sealant, the concentration was

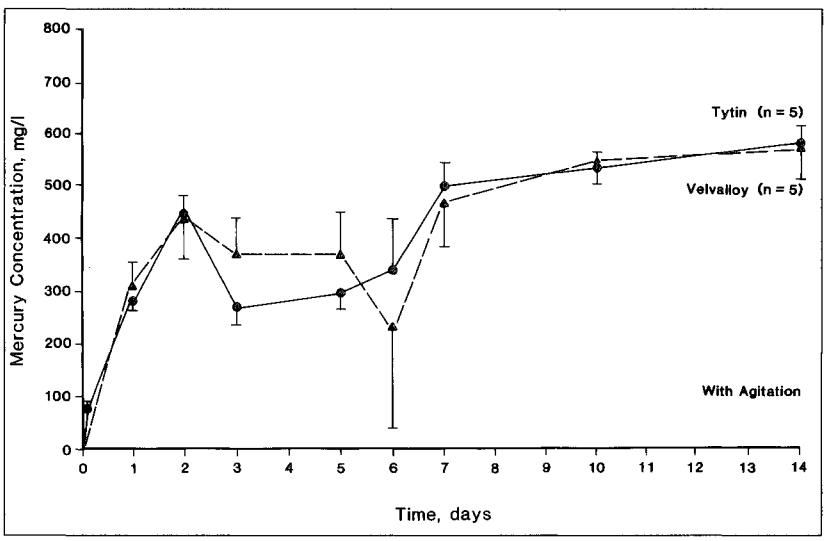

FIG 4. *Total mercury release from Velvalloy and Tytin over time with agitation*

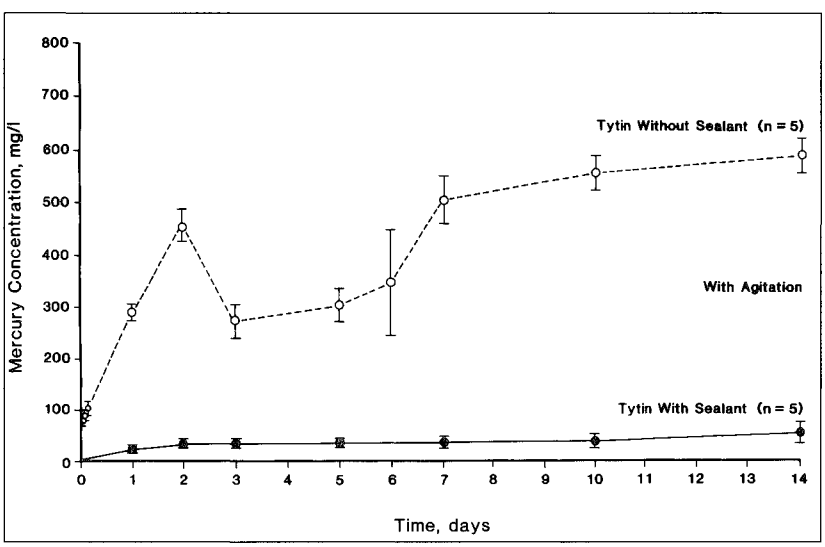

FIG 5. *Total mercury release from Tytin with sealant coverage and from Tytin without sealant under agitation conditions*

588 ppm ± 32 ppm. The reduction in mercury release by covering amalgam with sealant was about 11-fold.

Study in vivo

RESULTS OF THE VAPOR STUDY

Visit 2, Restorative: Figure 6 presents the change in intraoral mercury vapor concentration from baseline to the end of the restorative visit. For control and experimental groups, there was no significant difference in the average baseline readings of 0.1 $\mu g/m^3$ for control and 0.5 $\mu g/m^3$ for the experimental group. For both groups there was a significant increase from baseline mercury vapor levels to the rubber dam stage. There was a significant decrease in the experimental group by applying the sealant at the rubber dam stage. Application of sealant while the rubber dam was in place produced no significant difference when compared to measurements taken after the final rinse. A significant difference between control and experimental treatment was observed after the final rinse (50 ± 27.6 $\mu g/m^3$ compared to 20.6 ± 17.2 $\mu g/m^3$ for the experimental group).

Visit 3, One-day recall: All patients were available for recall except one in the control group.

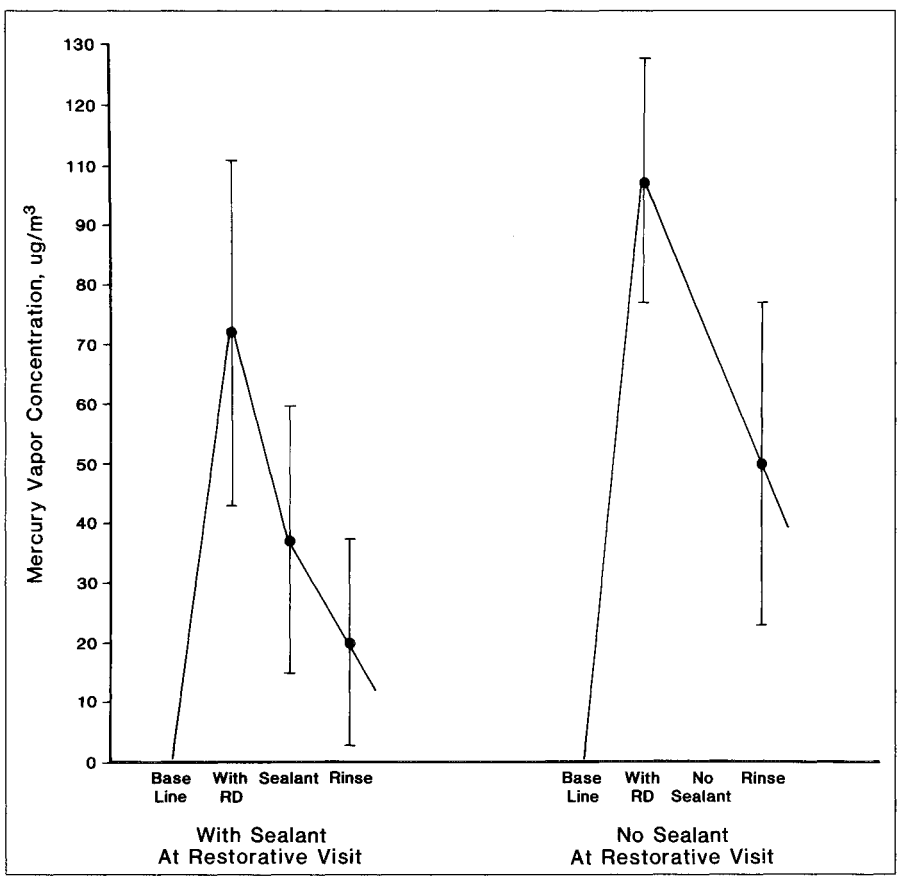

FIG 6. *Change in intraoral mercury vapor concentration from baseline to the end of the restorative procedure for the control and sealant-covered amalgam*

Mercury vapor levels (Fig 7) before chewing gum, although higher for the control group, were not more significant than the experimental treatment. After chewing gum for 10 minutes, however, a significant reduction in mercury was observed for the experimental group. The experimental group produced a vapor reading of 5.6 ± 2.5 $\mu g/m^3$ while the control group measured 28.4 ± 27.4 $\mu g/m^3$. For both groups before chewing, vapor levels were significantly lower than the after-chewing vapor levels. The average increase in mercury vapor from before chewing to after chewing for the experimental group was 2.4 times while the control increased by a factor of 11.2

Visit 4, Seven-day recall (Fig 7): All patients were available for recall.

As observed at the one-day recall, the after-chewing vapor levels of mercury were significantly higher for both treatment groups compared to the before-chewing levels. For the control group, the average increased 6.76 times; the experimental group showed a fourfold increase from the before-chewing levels. The after-chewing vapor level in the experimental group was 7.2 ± 7.1 $\mu g/m^3$ while in the control group it was 41.4 ± 27.1 $\mu g/m^3$. There was no statistically significant difference in the after-chewing mercury vapor levels of the experimental group from the day-one to the day-seven recall. This allows us to speculate that sealants do provide protection for up to seven days. All sealants in the experimental group were retained up to seven days.

RESULTS OF THE SALIVA STUDY

The collection of the saliva samples posed some problems. Some of the younger subjects were unable to produce sufficient amounts of saliva for testing even with the help of chewing gum. Comparison of baseline levels of mercury was not performed due to missing data in this group. However, since the concept of using sealant coverage to reduce mercury from amalgam is being studied, some of the significant differences between the two groups are noted

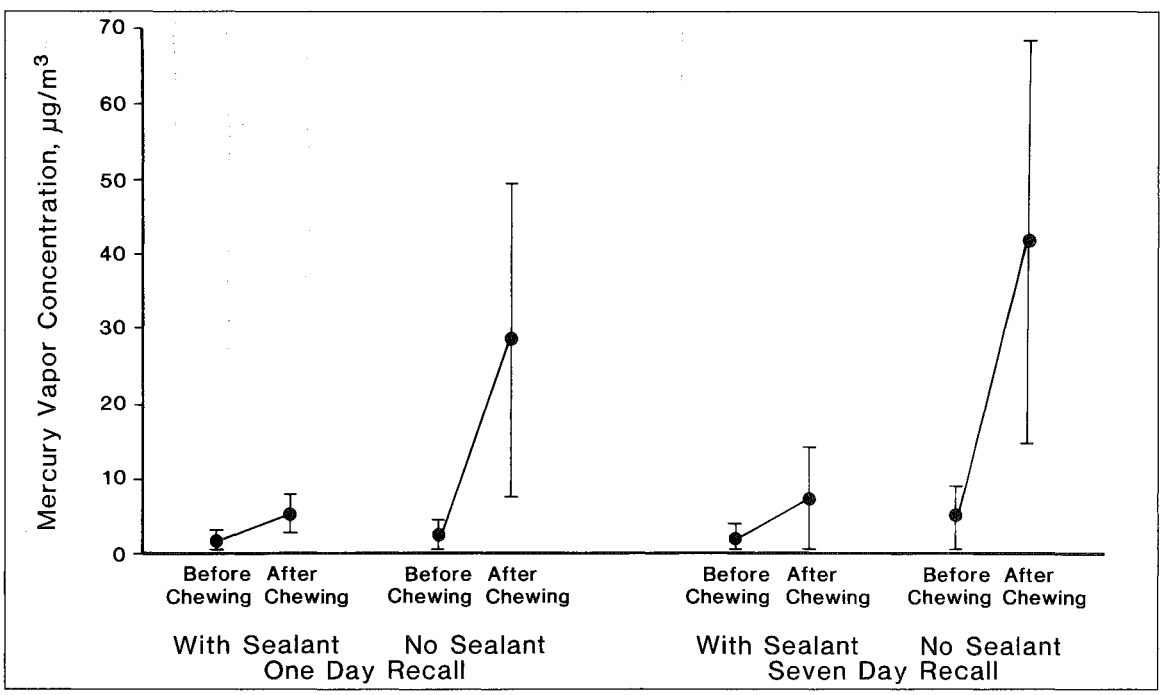

FIG 7. *Change in intraoral mercury vapor concentration from day one to day seven after chewing gum for 10 minutes for control and sealant-covered amalgam*

here. At the recall visits statistically significant differences (Fig 8) were indicated for day one and day seven; the control group showed higher saliva mercury concentration than the experimental group. Both concentrations of mercury in saliva on each recall in the control group were higher than both the day-one- and day-seven-recall concentrations in the experimental group. This was statistically significant. The control group mercury concentration at day one was 28.5 ± 22.3 ppm. At day seven the average for the control group was 16.3 ± 6.9 ppm after 10 minutes of chewing. It must be remembered that total mercury released in saliva was not being reported as the subject was allowed to swallow during that time.

For the experimental group the average concentration of mercury in saliva at day one was 6.0 ± 2.1 ppm and at day seven the average was 10.1 ± 6.6 ppm. There was no significant increase in mercury concentration from day one to day seven for either group.

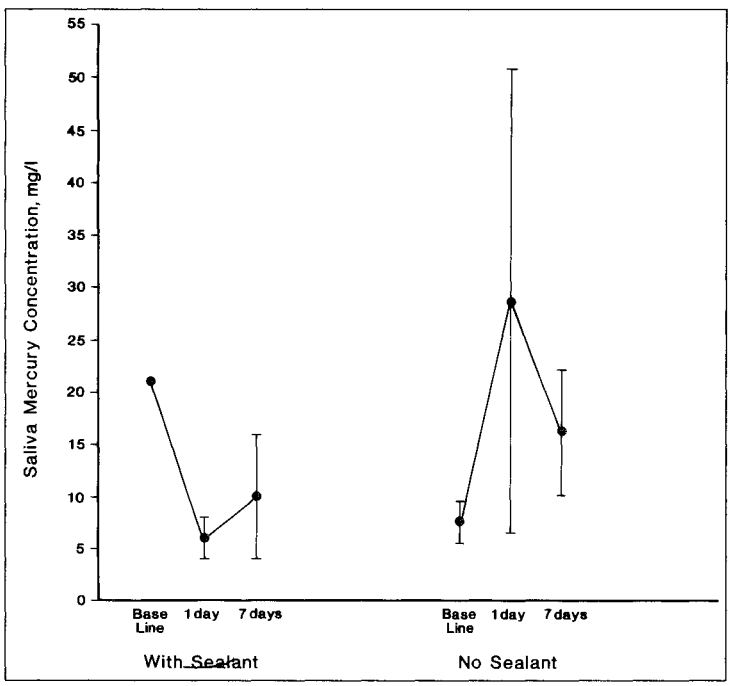

FIG 8. *Mercury concentration in saliva after chewing gum for 10 minutes when measured at the restorative procedure, at day one, and at day seven*

DISCUSSION

In the present study, total mercury release from amalgam samples was measured. That is, not only mercury in solution, but particles due to abrasion of the specimen were analyzed. Placement of the specimen into the test tube also may have loosened particles from the specimen which would have been measured. Under conditions of agitation, mercury release reached a maximum within 24 hours and thereafter stabilized.

Under conditions of agitation the total amount of mercury measured also did not increase over longer periods of time. The early fracture of the sharp edges of the specimen and early mercury release may account for increased mercury levels during shorter intitial time intervals. Failure to note continued increases in mercury release may be attributed in part to the marked rounding of the specimens observed and the lack of aggressive wear during the experiment. Other studies also suggest that formation of an oxide film of tin and zinc on the surface of amalgam may contribute to reductions in mercury release (Okabe & others, 1987).

The simulated abrasion indicated here was less than reported in similar wear studies. As such, the mercury levels in vitro indicated here may be much lower than clinical values as abrasion contributes to both mercury vapor and particle ingestion (Rowland, Davies & Evans, 1980; Heintz & others, 1983; Enwonwu, 1987). Values obtained for volume loss from this method are significantly lower than those reported in the literature for abrasion of amalgam both in vitro and in vivo (McCabe & Smith, 1981; Lambrechts & others, 1984). For this reason the authors prefer the term "agitation" of the samples caused by the motion of the mixer rather than the term abrasion. In this experiment no differences between the low- and high-copper amalgam samples were noted.

Reports in the literature are conflicting as well about whether a low- or a high-copper amalgam releases more mercury (Ahmad & Stannard, 1987; Okabe & others, 1987; Kozono & others, 1982).

A large decrease in mercury from samples coated with sealant was shown in this study. Sealant application, due to sealant's impermeable nature, should limit mercury vapor as well as protect the sample from fracturing. Sealant-covered samples were subjected to agitation for test intervals of up to 14 days. A statistically significant increase in mercury release occurred from day one to day two. Mercury release from these samples after this interval remained stable.

The study in vivo baseline (no amalgam) mercury vapor level (0.1 $\mu g/m^3$) for the control group is in agreement with that reported by Svare and others (1981) of 0.26 $\mu g/m^3$. The mercury vapor level for the experimental group (0.5 $\mu g/m^3$) is also in good agreement with that measured by Vimy and Lorscheider (1985a) of 0.54 $\mu g/m^3$.

A 10-minute chewing period was selected for this study because in a 30-minute chewing cycle, it has been shown that mercury release is maximum from dental amalgams after 10 minutes of chewing and then levels off for the rest of the chewing period (Vimy & Lorscheider, 1985b). Vimy and Lorscheider (1985a) have reported a prechewing intraoral air concentration of mercury of 4.9 ± 0.9 $\mu g/m^3$ and a postchewing concentration of 29.10 ± 6.07 $\mu g/m^3$ in subjects with amalgams. Svare and others (1981) have reported 0.88 ± 0.64 $\mu g/m^3$ and 13.74 ± 19.02 $\mu g/m^3$ for pre- and postchewing averages respectively in subjects with amalgams. In this study, the control group (with no sealant coverage) had an average prechewing intraoral mercury vapor concentration of 2.5 ± 2.1 $\mu g/m^3$ at one day and 4.7 ± 4.0 $\mu g/m^3$ at seven-day recall. Postchewing concentration levels were 28.42 ± 27.4 $\mu g/m^3$ and 41.4 ± 27.1 $\mu g/m^3$ for day one and day seven postfilling respectively.

At the day-one recall, the average increase in mercury vapor concentration in the control group by chewing gum for 10 minutes was 11.2-fold and on day seven it was 8.78-fold. Vimy and Lorscheider (1985a) reported a sixfold increase and Svare and others (1981) reported a 15.6-fold increase after chewing gum in subjects with amalgams.

Differences in the results with subjects having a single restoration to the above-mentioned studies in which subjects had multiple restorations may be due to the following: first, in this study the subjects were asked to chew on the restored tooth; second, the collection tube was held directly over the restored tooth so that vaporized mercury was collected with minimum room air dilution or from exhaled air; third, in the cited studies the amalgam restorations were all older than one year.

The potential for mercury reduction after coverage with sealant has been demonstrated in this study for up to seven days. The postchewing mercury vapor level in the mouth was significantly lowered by this procedure. After chewing, the increase in mercury vapor concentration was 2.4 times on day one and 4.0 times on day seven; this compares with an 11.2-fold increase on day one and an 8.78-fold increase on day seven for the control group. A point of interest is that after chewing, mercury vapor readings for the experimental group, on both recalls, were not significantly higher than the before-chewing levels of the control group at the day-seven recall. This indicates that the amalgam restorations with sealant coverage emitted as much mercury vapor after chewing as an amalgam with no sealant at rest.

Analysis of saliva also showed reductions in mercury concentrations from subjects with sealant-covered amalgams. This indication, however, was from a reduced sample size. It should be noted that total mercury released in saliva is not being reported as the subject was allowed to swallow during that time. It was at the end of 10 minutes that saliva was collected for testing purposes over approximately 30 seconds to one minute. One may expect that mercury release in saliva is much more than that reported here over 10 minutes of chewing. Sealants may also act as a barrier to the corrosive conditions of the oral cavity which, as stated by Svare (1984), have a marked effect on the rate of mercury evaporation from dental amalgams.

In this procedure after applying the sealant, occlusion should be checked again to eliminate occlusal interferences. Complete retention of the sealant was observed up to seven days in this study, but as advocated for pit and fissure application, fresh sealant may be reapplied if material loss takes place over time. Areas of concern for further investigation include long-term retention studies and the amount of

mercury released once the sealant wears away. Recently Mertz-Fairhurst and others (1987) reported that at six months, 76% of sealed amalgam restorations in their study remained fully covered with sealant.

CONCLUSIONS

Under conditions of agitation, mercury release from amalgam increases significantly compared to no agitation. Sealant coverage of amalgam significantly decreases release of mercury from amalgam when tested under conditions of agitation. Under the conditions in vitro of this experiment, mercury release occurred primarily within 24 hours.

From the clinical study, dental amalgams covered with sealant released significantly lower mercury than those that were not covered with sealant. Sealant application can reduce the initial release of mercury from dental amalgam. This method can reduce mercury exposure during the critical early period after amalgam placement. Further investigation is recommended to study the long-term effectiveness of sealant coverage of amalgam.

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A Two-Year Evaluation in Vivo and in Vitro of Class 2 Composites

A B FUKS • A CHOSACK • E EIDELMAN

Summary

Nineteen class 2 Herculite restorations were evaluated two years after placement. Nine of these were retrieved and examined by clinical inspection out of the mouth. Six of the restorations were then removed and the cavities examined for extent and location of discoloration and secondary caries. Radiolucent defects at the gingival margins were seen in 36% of the teeth. Gaps were evident in 58% of the gingival margins of the retrieved teeth. Secondary caries was diagnosed in four cases, all of them at the cervical margin. Examination of the cavities after removal of the composite resin demonstrated the penetration of the carious process into the dentin.

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Introduction

In a recent report Kanca (1988) suggested that restorations in posterior teeth should be viewed in terms of function, with different demands between their occlusal and approximal components. For the occlusal area the restorative material should mainly be wear-resistant, and provide for tooth strength. The major demands for the approximal components, according to Kanca, were: 1) radiopacity, 2) ability to seal tooth structure, 3) proper cure, 4) cariostasis, and 5) biocompatability. Although we feel that all the listed properties are also important for the occlusal areas, they are definitely more critical when the approximal surfaces are concerned.

Clinical research reports have shown that resistance to wear, initially a reason for concern, is similar or exceeds that of amalgam in several

posterior composites (Gilpatrick, Goldberg & Simonsen, 1987; Braem & others, 1987; Teixeira, Isenberg & Leinfelder, 1987; Christensen, Christensen & Bangerter, 1987). However, the gingival cavosurface margin of class 2 resin restorations remains a focus of concern, and several methods have been proposed to increase marginal adaptation and reduce microleakage (Lui & others, 1987; Lutz & others, 1986). Studies in vitro (Jorgensen & Hisamitsu, 1984; Lui & others, 1987) demonstrated that microleakage could be reduced when the restoration was placed incrementally. We found no difference in performance when class 2 composite restorations were placed in horizontal increments or in bulk in primary molars of schoolchildren (Eidelman, Fuks & Chosack, 1989). In that study, excellent occlusal margins were observed in over 90% of the restorations one year after placement. Direct inspection of 19 approximal surfaces of some of the teeth, recovered after exfoliation or extraction, revealed the presence of defects mainly at the cervical margins, despite the filling technique employed. Caries, however, was diagnosed in only two cases. The presence of crevices and staining at the margins indicated the presence of microleakage, and the potential for caries development with time.

The aims of this study were: 1) to evaluate clinically and radiographically the performance of class 2 composite restorations placed in primary molars using bulk and horizontal incremental filling techniques two years after placement, 2) to assess the gingival, buccal, and lingual cavosurface margins of the approximal box by direct inspection of the retrieved teeth, and 3) to assess the extent of discoloration and caries penetration in the retrieved teeth by direct inspection of the cavity preparation, following careful removal of the restorations.

Materials and Methods

A total of 60 class 2 cavities in primary molars were filled with Herculite (Kerr/Sybron, Romulus, MI 48174) either in bulk or in three horizontal increments. A detailed description of the clinical procedures has been reported (Eidelman & others, 1989). Briefly, conventional class 2 cavities were prepared and lined with Dycal (L D Caulk, Milford, DE 19963). The enamel margins were etched for 60 seconds, rinsed with water, air-dried, and two layers of an enamel-dentin bonding resin (Bondlite, Kerr/Sybron) were applied to all cavity surfaces and margins. Stainless steel "T" bands and wooden wedges were utilized. The first two increments were placed up to the pulpal wall and cured for 20 seconds each, and the third was cured for another 20 seconds. The restorations placed in bulk were cured for 60 seconds. Following matrix and wedge removal, the lingual and buccal embrasures were irradiated for another 20 seconds each in both groups.

Fifty-eight restorations were available for clinical and radiographic assessment after one year. Of these, 27 had been restored incrementally and 31 by utilizing the bulk technique; the results of this examination have been reported (Eidelman & others, 1989). Sixteen of these restorations were recovered after extraction or exfoliation and were assessed after one year (Eidelman & others, 1989; Fuks, Chosack & Eidelman, 1990). Twenty-five additional restorations were lost due to exfoliation or lack of patient response to the recall appointment. Therefore, this is a report of the clinical and radiographic evaluation of the remaining 19 restorations (with 22 approximal surfaces) two years after placement.

The children were examined clinically and bitewing radiographs were taken. The restorations were evaluated for surface appearance, color match, marginal adaptation, marginal discoloration, anatomic form, and secondary caries using the criteria described by Cvar and Ryge (1971).

Nine of these 19 restorations were retrieved and examined by clinical inspection out of the mouth, using an explorer, and assessed by the same criteria. These nine restorations included 12 approximal surfaces. After the evaluation, six of these restorations were partially removed using a blunt #330 carbide bur mounted on a high-speed engine with water coolant. When only a thin layer of composite resin remained, it was pried off with an explorer. The cavity was then directly examined for extent and location of discoloration, and for secondary caries, and photographs were taken.

Results

All the occlusal surfaces were rated Alpha for all the parameters assessed. The radiographic findings of the 22 approximal surfaces are

presented in Table 1. No appreciable difference was found between the two filling techniques. Radiolucent defects at the gingival margins of the approximal surface were seen in 33.5% of the incremental restorations (three out of nine) and in 38% of the ones restored in bulk (five out of 13). No attempt was made to differentiate between inadequate filling, shrinkage, or secondary caries.

Table 1. Findings of the Radiographic Examination

Filling Technique	Number of Surfaces	No Defect	Defect at the Cervical Margin
Incremental	9	6 (66.5%)	3 (33.5%)
Bulk	13	8 (62%)	5 (38%)
Total	22	14 (64%)	8 (36%)

The findings of the visual and tactile assessment of 12 approximal surfaces of class 2 restorations in retrieved primary molars are summarized in Table 2. Surface appearance, secondary caries, marginal adaptation, and discoloration were evaluated. The last two criteria were rated separately for the buccal, lingual, and cervical margins. Since no statistically significant differences were found between the two filling techniques utilized, the findings were pooled. Only 58.3% rated Alpha for surface appearance, and pitting was present in 41.7% of the surfaces examined. Adaptation at the gingival cavosurface margin was considerably worse than that of the buccal and lingual margins. Gaps were evident in over 58% of those margins (scores Bravo and Charlie) as opposed to only 16.7% of the buccal and 25% of the lingual margins (score Bravo). Marginal discoloration was also more pronounced at the cervical margin. Secondary caries was diagnosed in four cases, all of them at the cervical margin.

Table 2. Visual and Tactile Evaluation of Approximal Surfaces of Retrieved Teeth

	Rating		
Criteria Evaluated	**Alpha**	**Bravo**	**Charlie**
Surface appearance	7 (58.3%)	-	5 (41.7%)
Marginal adaptation			
Cervical	5 (41.7%)	6 (50%)	1 (8.3%)
Buccal	10 (83.3%)	2 (16.7%)	-
Lingual	9 (75%)	3 (25%)	-
Marginal discoloration			
Cervical	7 (58.3%)	1 (8.3%)	4 (33.3%)
Buccal	11 (91.7%)	1 (8.3%)	-
Lingual	10 (83.3%)	2 (16.7%)	-
Secondary caries	8 (66.7%)	-	4 (33.3%)

Examination of the cavities after removal of the composite resin demonstrated the penetration of the carious process into the dentin, even when minor marginal staining was evident. Moreover, in the only case where no marginal discoloration was observed at the cervical margin, caries, as expressed by tissue stain, was limited to the enamel. An example showing the radiographic picture, the clinical appearance of the approximal surface following exfoliation and the extent of caries penetration into the dentin after removal of the restoration is presented in Figures 1 to 3.

Discussion

The high rate of success of the restorations when examined clinically after two years reinforces the findings of previous reports (Oldenburg, Vann & Dilley, 1985; Paquette & others, 1983). However, defects were observed at the gingival margin in 38% of these restorations when examined radiographically. These could be due to polymerization shrinkage, inadequate adaptation of the material to the gingival wall, and contraction of the material toward the light source (Lui & others, 1987).

As in previous reports (Varpio, 1985; Eidelman & others, 1989), the cervical margin presented the greatest percentage of defects and discoloration when the retrieved teeth were examined. The striking finding in the present study is the extent of caries penetration under a discolored margin, without the presence of a clinically detectable gap or crevice, confirming the presence of microleakage.

Brännström (1984a) has commented on the importance of the cervical gaps which are

FIG 1. *Bitewing radiograph showing a restored mandibular second primary molar close to exfoliation. No caries can be detected at the cervical margin.*

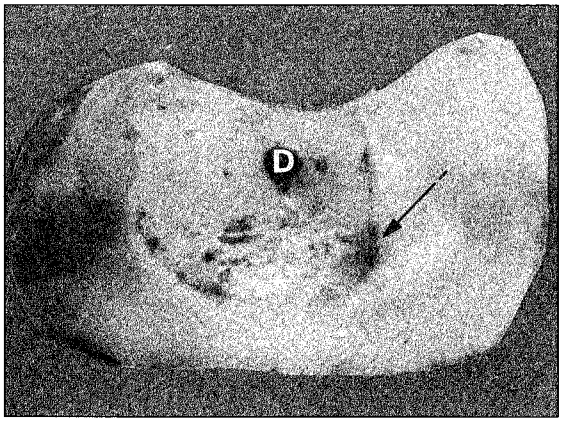

FIG 2. *Clinical appearance of the distal surface of the same mandibular second primary molar after extraction. Notice the presence of defects on the composite material (D) and signs of marginal discoloration (arrows).*

present when the composite margin is placed in dentin or cementum. He stressed that as the material polymerizes, it pulls away from dentin, resulting in a gap which allows bacterial penetration. Subsequent hygroscopic expansion of the resin may compensate somewhat for this shrinkage. However, Brännström recommends that these gaps should be occluded by application of an unfilled resin after a restoration is placed. Cervical gaps may be even a greater problem in terms of pulp irritation and postoperative sensitivity with some of the newer materials (specifically, posterior composites) which undergo little or no hygroscopic expansion (Brännström, 1986b;

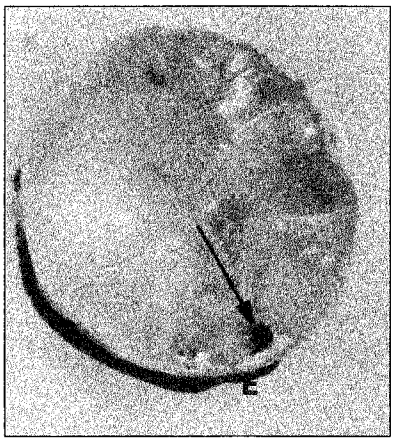

FIG 3. *Photograph of the cavity preparation of the same tooth after removal of the composite resin showing the presence of caries in the dentin (arrow) and the white demineralized cervical enamel (E).*

Swift, 1989).

The presence of cervical defects is due not only to polymerization shrinkage but to a combination of factors such as thin enamel margins, poor adherence of the material to the gingival wall, and difficulty in condensation of the material. In this study, metal bands, wooden wedges, and a horizontal incremental filling technique were employed. Transparent matrices and wedges were not available when the restorations were placed. A significantly lower rate of cervical defects was reported by the same group in another study where these bands and matrices were used in conjunction with a vertical increment technique (Holan, Chosack & Eidelman, 1989).

Conclusions

It was concluded from this study that an improvement in the filling technique was necessary, since caries was present even under fillings that presented a normal radiographic image (Figure 1).

Quoting the Clinical Research Associates Newsletter (1989), new optimism is developing in favor of class 2 resin restorations. These authors list several concepts and developments that improved class 2 resins: 1) a realization that resin is more difficult to manipulate and requires more time and a higher fee, 2) identification of

contraindications for resin use such as patients with abusive occlusal habits (bruxing, clenching, nervous grinding, for example), and 3) accessory products and techniques to maximize resin potential, such as dentin adhesives, dispensing that allows direct placement into the cavity, nonsticky placement instruments, improved curing lights with higher intensity output and with operator control of set, and transparent matrices and wedges.

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DENTAL PRACTICE

Fabrication of a Crown to Fit an Existing Partial Denture Using Castable Glass

A P RAPPOLD • E J IRELAND

Summary

In this case report, an accepted technique was used to fabricate a crown to fit an existing removable partial denture in which castable glass was used instead of gold. The use of castable glass allowed the crown to be cast directly from a wax-acrylic pattern and eliminated the need for templates to produce accurate facial contours in porcelain. Although castable glass has limitations and cannot be used in all such situations, the material can be used in selected cases where esthetics is important.

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INTRODUCTION

The construction of a crown to fit an existing removable partial denture has been the subject of dozens of articles published over the last 30 years and is a testament to the difficulties that can be encountered.

The techniques can be divided into those in which an impression of the prepared tooth is made with the removable partial denture in position and with the patient surrendering the removable partial denture during the laboratory phase (Kahl, 1963; Steinert, 1964; Barrett & Pilling, 1965; McArthur, 1984), and those in which the patient can retain the removable partial denture (Killebrew, 1961; Brownfield, 1963; Osborn, 1964; Geldmeirer, 1964; Lee, 1970; Thurgood, Thayer & Lee, 1973; Welsh, 1975; Goldberg & Jones, 1976; Hill, 1977; Loft, Reynolds & Lundquist, 1977; Gavelis, 1981; Raskin, 1983; St Arnault & Willer, 1984; Getz, 1985; Taleghani & Morgan, 1986).

One technique (Raskin, 1983) suggested duplicating the denture clasp and rest area in low-fusing metal so that the wax-up could be completed indirectly. Some direct-indirect techniques recommended that crown patterns be made

from gold shell crowns (Geldmeier, 1964) or even cadmium metal shells (Ewing, 1965). Another advocated forming acrylic around the clasp to make a single-tooth impression tray within the removable partial denture (Warnick, 1970) while still another suggested casting a gold coping to fit the preparation, then casting a crown onto the coping, and finally soldering the two together (Loft & others, 1977).

The problems are further compounded when the clasp must also accurately fit the facial surface of a ceramometal crown. Welsh (1975) suggested carefully adjusting the facial surface by trial and error until the proper clasp retention was attained. Lubovich and Peterson (1977) suggested a plaster template to mold the correct contour in the porcelain before baking, Getz (1985) and Taleghani and Morgan (1986) suggested a vaccuform template, and Diaz-Arnold, Langenwalter and Hatch (1989) suggested a template made from silicone.

The purpose of this article is to utilize the best of these techniques and combine it with the use of a new material, castable glass (Dicor, Dentsply International, Inc, York, PA 17405-0872), to produce a ceramic crown directly from the pattern that will accurately fit an existing removable partial denture.

TECHNIQUE

Clinical Phase

Before beginning any restoration of this type, the operator should determine that the abutment tooth itself is periodontally sound, the adjacent oral tissues are healthy, and that the partial denture is serviceable.

The crown preparation for a cast-glass crown should be modified so that there is a 1.5 mm shoulder for a butt-joint gingival margin circumferencially and a 1.5-2.0 mm occlusal or incisal clearance. There should also be adequate clearance (1.5 mm) for all internal surfaces of the existing prosthesis. The remainder of the technique is essentially the same as for a solid gold crown.

1. Prepare the abutment tooth for a full crown with sufficient clearance as described above. These reductions are mandatory for castable glass.
2. Make a final rubber impression of the prepared abutment without the removable partial denture in place.
3. Lightly lubricate the clasp and rest area of the removable partial denture and the preparation.
4. Begin the fabrication of a Duralay (Reliance Dental Manufacturing Co, Worth, IL 60402) acrylic pattern by adapting a small amount of doughy resin around the preparation and fully seat the removable partial denture.
5. Using a camel's hair brush, paint on additional monomer and resin alternatingly until all inner surfaces, resets, and clasp areas of the removable partial denture are incorporated in the resin pattern.
6. Allow the pattern to set for approximately two minutes. As it completes the set, remove the partial denture and the resin pattern as one unit. It is important that the resin material not cover the external surfaces of the clasps or rest, but only contact and reproduce the inner surfaces.
7. When completely set, gently remove the pattern from the removable partial denture in a gingival direction. If there is excess resin overlapping the rest and clasps or near the margin, it must be removed with a stone or knife.
8. Drill a small hole through the pattern occlusally in a noncritical area, so that when it is replaced on either the tooth or the die complete seating can be verified.
9. Replace the pattern on the tooth and insert the removable partial denture to verify complete seating and proper fit of the clasp and rest (Fig 1).
10. Adjust the occlusion and contours. No opposing cast is necessary.
11. Repeat the procedure using tooth-colored acrylic resin to make a temporary crown so that

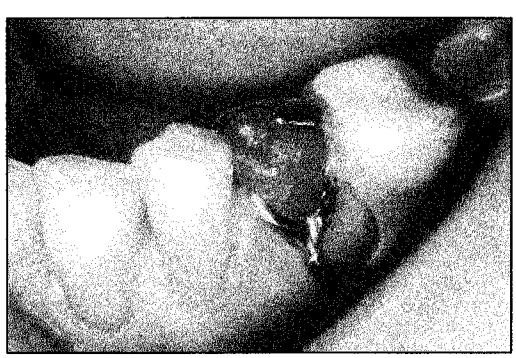

FIG 1. *Duralay pattern seated with removable partial denture in place*

the patient can wear the removable partial denture until the next appointment (Fig 2).

12. Inspect the Duralay pattern and re-define the suprabulge area of the pattern with a small amount of inlay wax to allow the clasp to be retentive.

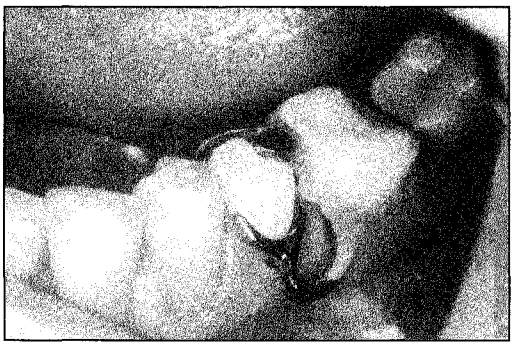

FIG 2. *Tooth-colored temporary crown*

Laboratory Phase

1. Trim 2 mm of the Duralay pattern away from the margin.
2. Place the pattern on the die made from the final impression and verify complete seating through the small hole in the pattern.
3. Incorporate the Duralay pattern into the completed wax-up (Fig 3).
4. Submit the completed wax-acrylic pattern to a dental laboratory equipped to fabricate crowns made from castable glass.

Little or no adjustment should be necessary at the delivery of the crown (Figs 4 & 5). The finished crown can be cemented with zinc-phosphate or glass-ionomer cement or it can be bonded to the tooth using Dicor dual-cured composite resin cement. It is suggested that finger pressure alone be applied during the cementation process and that the removable partial denture should be in place during cementation.

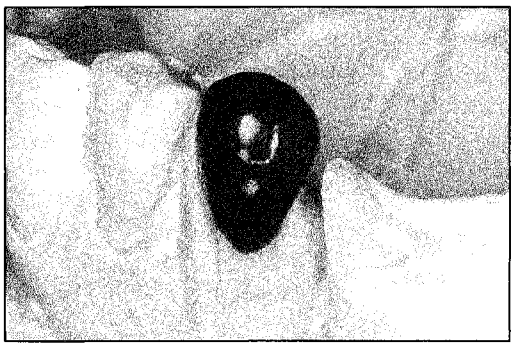

FIG 3. *Completed wax-acrylic pattern on the die*

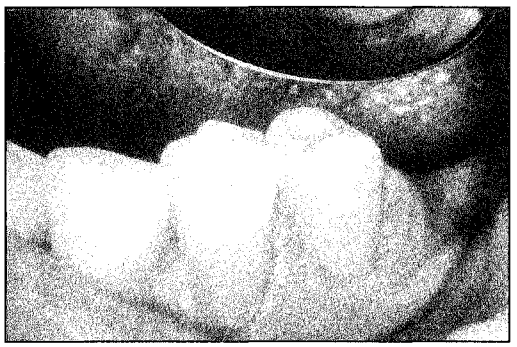

FIG 4. *Completed crown try-in*

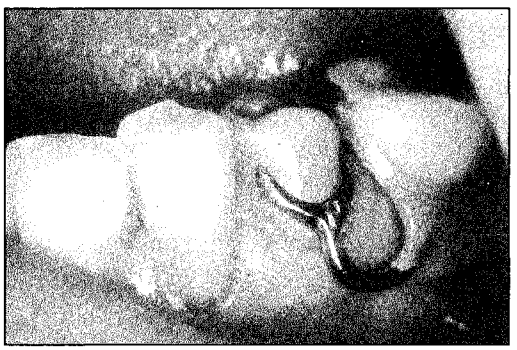

FIG 5. *Crown cemented with removable partial denture in place*

DISCUSSION

According to Malament and Grossman (1987), castable-glass material is not presently intended for use in fixed partial dentures or removable partial dentures with deep rests or internal attachments. However, the successful use of cast-glass ceramic material for full-coverage single restorations has been reported by Lugassy, Moffa, and Ellison (1986) and Brown (1987). Their success was based on careful case selection in which close adherence was given to the

requirements of tooth preparation and occlusal reduction as well as a good understanding of the handling properties of castable glass.

In this case, the fit of the crown at cementation was excellent and the removable partial denture snapped into the place and was comfortable to the patient. Recall after six months and again after one year did not reveal any crown wear clinically at the crown-clasp interface, and the patient expressed continued satisfaction.

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Distinguished Member Award

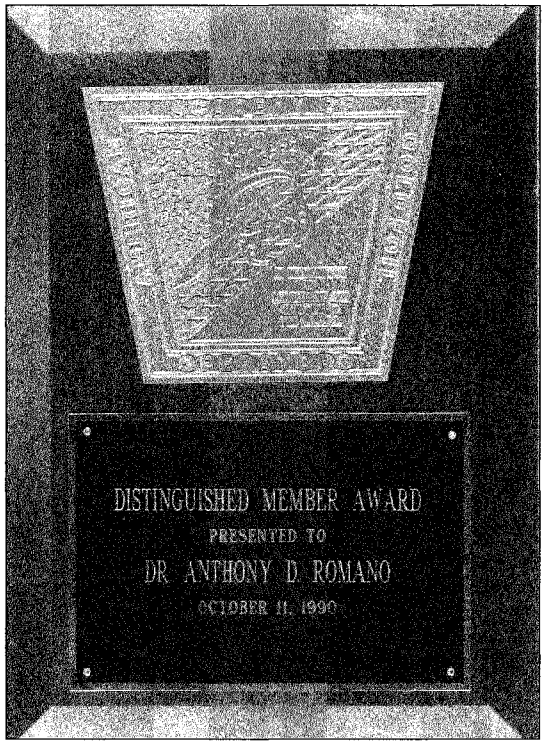
Every year the American Academy of Gold Foil Operators selects a member for the Distinguished Member Award. This year it goes to a very special person who has become an important part of the history of dentistry. The University of Minnesota this year is celebrating the First One Hundred Years of Excellence in Dentistry. This is the history and tradition of our profession, a tradition founded by greats like Searl, Walls, Weidelstat, and G V Black. Our award recipient, Dr Anthony D Romano, is a continuing part of this history and tradition. Like his predecessors, his expertise covers a wide area.

First, he is a teacher. Almost immediately after his graduation from the University of Minnesota Dental School in 1954, he started teaching in the Department of Periodontics. In 1964, he moved to the Operative Department. He was chairman of this department from 1971 to 1977, and since that time he has continued on as a professor there. For this dedication and the many other contributions he has made to his alma mater he recently received the coveted Ambert B Hall Alumni Award.

Tony is also an author. He has had several articles published in various dental journals such as the *Journal of Oral Pathology*, *Northwest Dentistry*, and the *Journal of Operative Dentistry*. He has had two articles accepted for publication in the *Minnesota Archaeologist*, and has submitted one other to the *Wisconsin Archaeologist*. Also, he has been asked to write the Operative History for The One Hundred Years of Excellence of Dentistry.

Anthony D Romano

Tony Romano is an exquisite operator. Most of us have seen his restorations at academy meetings. His zest for excellence spills over into



Distinguished Member Award for 1990

everything he does. He is a long-time member of the G V Black Gold Foil Study Club, both as an operative member and mentor.

He is an organization man. Not only has he been president of his district dental society but of many other organizations. He was president of this Academy in 1977--the year of our only trip to Hawaii.

Tony is an archaeologist, anthropologist, and a naturalist. He knows more about more things than anyone I have ever known, from Indian pictographs to rocks. If Tony can't tell you, he has a book in which to look it up. Although his training in these fields was not in a formal setting, his knowledge is such that he has been asked to lecture at archaeology meetings many times, and is a member of the Minnesota Archaeology Society.

Tony is an artist. I remember one time on a trip into British Columbia, Tony and I found a flower that neither of us could identify. That evening he sat down with this flower and drew the most beautiful sketch of it with the pistils, petals, and leaves perfectly reproduced so he could find it in his library back home.

There are so many more things that could be said about Dr Romano that time does not allow, from his ability to knap a perfect spear or arrowhead in a matter of minutes to his keen sense of recognizing all small dead birds as Pine Siskens.

Tony, we salute you and applaud your contribution to our profession and this Academy. It is a great honor to present you with the Distinguished Member Award.

CHESTER J GIBSON

DEPARTMENTS

Press Digest

The editor wishes to thank the second-year General Dentistry Residents at Wilford Hall USAF Medical Center, Lackland AFB, Texas, for their assistance in the preparation of the following abstracts.

Effect of insertion technique on microleakage in mesio-occlusodistal composite resin restorations. *Eakle, W S & Ito, R K (1990) *Quintessence International* 5 369-374.

(*University of California at San Francisco, School of Dentistry, Department of Restorative Dentistry, San Francisco, CA 94143)

This study investigated four methods of incremental insertion of composite resin into MOD cavity preparations to determine the effect of each method on microleakage at cervical margins. Forty extracted teeth were restored with a light-curing, hybrid composite resin and its bonding agent in one of the following methods: (1) single-increment insertion, (2) two horizontal layers in the approximal box and one layer in the occlusal portion, (3) two diagonally placed layers in the approximal box and one layer in the occlusal portion, and (4) a glass-ionomer liner (dentin was not conditioned) placed on the axial wall and gingival floor followed by two diagonally placed resin layers in the approximal box and one resin layer in the occlusal portion. The teeth were thermocycled, stained with silver nitrate, sectioned mesiodistally, and scored for microleakage. While the diagonal insertion technique without the glass-ionomer liner produced the least amount of microleakage at the enamel margins, its microleakage was not significantly different from that produced by the single-increment technique. A glass-ionomer lining cement did not prevent microleakage when the smear layer was left intact. None of the insertion techniques was able to prevent microleakage at cervical margins on the root surface.

In vitro and clinical examination of the effect of an antimicrobial impression material on the oral microflora. *Brauner, A W (1990) *Dental Materials* 6 201-203.

(*Dental School of the RWTH Pauwelsstrasse, Department of Conservation, Periodontology and Preventive Dentistry, D-5100 Aachen, West Germany).

In the continuing development of products to meet perceived infection-control needs, this study was designed to test the antibacterial/antiseptic properties of a new irreversible hydrocolloid, "Blueprint asept" (De Trey/Dentsply, Konstanz, West Germany). The manufacturers claim that by the addition of an antiseptic substance to the alginate powder, pathogenic microorganisms are inactivated while not affecting the impression accuracy. Using both test cultures as well as clinically examining 30 patients, the author verified the claims of the manufacturer. Electromicroscopic examinations showed no reduction in accuracy of impressions taken with "Blueprint asept" as compared with current alginate materials.

Clinical evaluation of a single crystal sapphire tooth implant in human beings. *Sclaroff, A, El-Mofty, S & Guyer, S E (1990) *Oral Surgery, Oral Medicine, Oral Pathology* 70 141-146.

(*Washington University, School of Dental Medicine, Department of Oral and Maxillofacial Surgery, 4559 Scott Avenue, St Louis, MO 63110)

This paper presents the history of sapphire (aluminum oxide) endosseous implants and briefly describes the technique, as well as its successes and failures. This background is followed by a discussion of two clinical cases. The histology of the implant-bone interface is described; it appears to be consistent with osseous integration. Sapphire implants have been placed at Washington University since 1978 and have been followed clinically and radiographically with success. The researchers conclude that

sapphire is well tolerated by hard and soft tissues and that it can serve as an excellent abutment for fixed partial dentures. However, comparisons to titanium or hydroxylapatite implants were not made.

Tensile bond strength of dentin adhesives: a comparison of materials and methods. *Oilo, G & Olsson, S (1990) *Dental Materials* 6 138-144.

(*NIOM, Scandinavian Institute of Dental Materials, Kirkeveien 71B, POB 70, N-1344 Haslum, Norway)

The purpose of this study was to compare tensile bond strengths of four dentin bonding agents under two different tensile test methods. Four dentin adhesives (Gluma, Scotchbond [dual], Scotchbond 2, and Tenure) applied to occlusal dentin were stored in water for 24 hours at 37 °C or thermocycled, and then tensile-tested by one of two methods. Thermocycling reduced the bond strength significantly for all materials except Gluma, as compared with water storage. The type of dentin as well as the choice of tensile test method changed the bond strength values significantly. One method gave as much as three times higher bond strength values for one material when used on the same type of dentin. Bond strength values obtained on buccal dentin were from 20% to 50% higher than those obtained on occlusal dentin with the same method. These results strongly suggest the need for the development of standardized testing parameters, especially in the extremely dynamic area of "adhesive" dental materials.

Colorimetric changes in composites resulting from visible-light-initiated polymerization. *Seghi, R R, Gritz, M D & Kim, J (1990) *Dental Materials* 6 133-137.

(*University of California at Los Angeles, School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90024)

This study evaluated three shades of nine light-cured composites to determine the colorimetric changes which occur as a result of the photopolymerization reaction. A photo-electric tristimulus colorimeter was used to measure the color of a 0.5-mm thick sample of composite on two different backgrounds before and after the polymerization. The results showed that each of the composites tested produced a visually significant change in color as a result of the polymerization reaction, regardless of the shade of the backing. As a general rule, the light-cured composites produced a characteristic chromatic shift toward blue, which resulted in a perceived decrease in yellow chroma. Therefore, direct shade selection of a resin composite which is more yellow or more chromatic than the tooth being restored is recommended to compensate for this characteristic color shift.

Effects of the XR Bonding System on microleakage. *Swift, Jr, E J, Hansen, B S & Bailey, S J (1990) *American Journal of Dentistry* 3 143-146.

(*University of Iowa, College of Dentistry, Department of Operative Dentistry, Iowa City, IA 52242)

Among manufacturers and researchers there seems to be a never-ending desire to develop the perfect bonding agent that will prevent ever-present and endemic microleakage. The purpose of this particular study was to evaluate Kerr's XR Bonding System in preventing microleakage, specifically on dentin or cementum margins of class 5 restorations on human molar teeth. Six groups were formed to test the various combinations of the bonding system and its placement close to or on the cavosurface margin. The authors reported that the resin dentin adhesive (XR Primer and XR Bond) did not effectively reduce microleakage. However, when used in combination with the XR Ionomer (glass-ionomer liner), the complete system allowed very minimal microleakage whether placed close to or on the cavosurface margin. The difference was statistically significant with the clinical significance left to the reader.

Book Reviews

LABORATORY TECHNIQUES FOR THE BRÅNEMARK SYSTEM

R L Taylor, MDSc, and G F Bergman, CDT

Published by Quintessence Publishing Co, Inc, Chicago, 1990. 80 pages, 228 illustrations (132 color). $42.00.

The authors provide a well-organized and well-illustrated laboratory manual that can be of great assistance to both technician and clinican. As the title states, the techniques described are limited to the use of the Brånemark components; however, the concepts can be applied to any implant system.

The text begins with the basics, describing the components and instrumentation as well as the construction of surgical and radiographic stents along with the rationale behind them. It then gives a thorough step-by-step discussion on the construction of a mandibular fixed complete denture, an implant-retained overdenture, an implant-supported fixed partial denture, and a single tooth replacement, in each case relating the pertinent clinical steps. Although the specific designs may vary, the basic concepts still apply.

The authors include references to substantiate claims made within the text and also give a suggested sequence of treatment incorporating both clinical and laboratory steps which can be helpful to clinicians and technicians new to the world of implant prosthodontics.

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NATURAL CERAMICS

David Korson, Dental Technician

Published by Quintessence Publishing Co, Inc, Chicago, 1990. 127 pages, 221 color illustrations. $68.00.

This text offers the dentist some helpful guidelines in shade selection, lighting conditions, and in recognizing the natural anatomical aspects of ceramic crowns. There is also a good discussion of optimal finish line configuration to satisfy esthetic and hygienic needs. Most of the discussion, however, is aimed primarily at the dental technician. There are nicely illustrated step-by-step porcelain buildup techniques for the young, middle-aged, and older dentitions. The use of opacous dentins and opalescent enamel powders is emphasized. Special effects such as abrasion and crack lines are also discussed. For those interested in improving posterior tooth form there are detailed descriptions and line diagrams reviewing natural anatomy as well as contact point locations. There is also a discussion of the recommended finishing techniques to create the appropriate texture and luster of the completed restoration.

The porcelain that the author uses is the Ducera Creative Color System and his techniques are discussed in terms of formulas from this specific system. It follows that those who would benefit the most from this text are dental technicians who are familiar with Duceram porcelain and are interested in experimenting with some techniques to improve the "natural look" of their ceramic restorations.

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CRANIOMANDIBULAR DISORDERS: Guidelines for Evaluation, Diagnosis, and Management

Edited by Charles McNeill, DDS

Published by Quintessence Publishing Co, Inc, Chicago, 1990. 54 pages. $18.00, softcover.

For the practicing clinician, this position paper is perhaps the most valuable treatise available on the TMJ today. This inexpensive, softcover document is a consensus paper by the American Academy of Craniomandibular Disorders (AACMD) on the current state of the art in the evaluation, diagnosis, and management of craniomandibular disorders (CMD). A 'must-have' book for anyone treating CMD, its major objective is to provide guidelines based on research and clinical practice experience. With so many articles on the TMJ appearing in an ever larger number of dental, medical, and allied health journals, the AACMD has accomplished a monumental task in meeting a critical need for appropriate practice guidelines.

Following the chapters on definition and prevalence of CMD, the section on diagnosis presents a new classification system for CMD based on the International Headache Society's Classification and Diagnostic Criteria for Headache Disorders, Cranial Neuralgias and Facial Pain. An important element of this standardized terminology is the use of the corresponding International Classification of Diseases code (ICD.9.CM) for each medical diagnosis category. Utilization of this new system by both clinicians and researchers should eliminate much of the present confusion created by use of different terms for the same disorder.

The chapter on evaluation is particularly noteworthy for its discussion of current imaging technology, behavioral and psychosocial assessment, and a review of techniques which have yet to be shown significant in diagnosis, e g, electromyography, thermography, and sonography.

The section on management focuses on conservative therapy utilizing a team approach, either interdisciplinary (one setting) or multidisciplinary (multiple settings). Treatment options reviewed in detail include patient education and palliative home care, behavior modification, pharmacotherapy, physical therapy, orthopedic appliance therapy, occlusal therapy, and surgery.

This book presents the diagnosis and management of CMD in a fashion similar to other musculoskeletal disorders in terms of accepted concepts of physiology, pathology, and psychology. As a guide, it will prove immensely helpful to those clinicians who recognize the multidimensional character of CMD and are not bound by a favorite theory or current fad.

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THE POLYCHROMATIC LAYERING TECHNIQUE: A Practical Manual for Ceramics and Acrylic Resins

Ludwig A Rinn, MDT

Published by Quintessence Publishing Co, Inc, Chicago, 1990. 160 pages, indexed, 400 illustrations, $78.00.

This book is directed to the dental technician and describes the technique for the layering of colors in ceramic and resin restorations. The layering of color from the opaque through the body and incisal porcelains will give a more realistic effect by altering the light transmission through the crown. This theory is discussed quite well in the first two chapters, which deal with light and how it interacts with the perception of color. The technique itself is rather complex in that it uses Vita porcelains to compose palettes containing different formulations of colors for each layer of the composition. This is similar in concept to the newer porcelain systems on the market that have these expanded color systems prefabricated.

Overall the text is a good reference for the understanding of color and its use in fabricating natural-appearing restorations.

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American Academy of Gold Foil Operators Awards Honorary Membership to Mrs Nell M Faucett

Mrs Nell M Faucett

For the past 10 years the American Academy of Gold Foil Operators has benefited from the exceptional efforts and talents of Mrs Nell M Faucett. When Dr Ralph Boelsche became the Adademy's secretary-treasurer, Mrs Faucett was his dental assistant. Dr Boelsche began delegating some of the responsibilities of the office to his "Miss Nell," and as he turned over more of those duties, she gradually became known as the administrative assistant and then in actuality the executive director. Her cheerful willingness combined with her imaginative and careful approach to the many duties have been thoroughly appreciated not only by the membership at large but especially by the many officers who have served on the Academy's Executive Council. As a result, upon her resignation from the duties of the office, the current Academy officers voted unanimously and enthusiastically to award her an honorary membership. Thank you, Mrs Nell M Faucett, for your untiring efforts and dedicated personal attention, which have been invaluable contributions to our Academy. You will be missed.

AMERICAN ACADEMY OF GOLD FOIL OPERATORS

The 40th annual meeting was held 10-12 October 1990 at Tufts University School of Dentistry and the Omni Parker House, Boston, Massachusetts. The Board of Directors meeting was held on Wednesday afternoon followed by a no-host cocktail "Welcome Party" in the hospitality suite. On Thursday morning, clinical demonstrations were given with 18 clinicians presenting two class 6, seven class 5, five class 3, three class 2 and one class 1 restorations to an enthusiastic group.

The participants enjoyed a bus tour of historic Boston in the afternoon. The day concluded with a reception and banquet at the Omni Parker House. The members and their guests were entertained by the Harvard Glee Club Light during the banquet. The banquet concluded with Dr Chester Gibson presenting the Distinguished Member Award for 1990 to Dr Anthony D Romano, Jr of Pine City, Minnesota.

Friday morning found the participants listening to eight exceptional presentations on the use of gold foil in many settings.

The officers of the Academy for the forthcoming year are: president, Michael A Cochran; immediate past president, William H Harris; president-elect, Alfred C Heston; vice president, Richard J Hoard; secretary-treasurer, Nelson W Rupp; and councilors, Ralph Lambert, Maurice Logan, and Glenn Birkitt.

Next year's annual meeting will be held in Vancouver, British Columbia, at the University of British Columbia School of Dentistry, 1-3 October 1990. Ted and Doreen Ramage are heading up the local arrangements committee and Richard Hoard is organizing the clinical session.

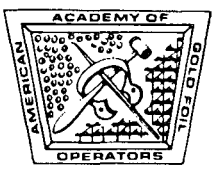
It is not too early to make plans to attend what promises to be another outstanding meeting in Vancouver. Plan to join us there.

Correction

An error was made in editing the paper by Jagadish and Yogesh, "Fracture Resistance of Teeth with Class 2 Silver Amalgam, Posterior Composite, and Glass Cermet Restorations," Vol 15(2):42-47. The error is on page 45, right column, third paragraph, sixth line. It should read " ... strength to a tooth in which an MO or DO cavity has been prepared."

The editor apologizes for the error.

OPERATIVE DENTISTRY



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OPERATIVE DENTISTRY

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.

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Submit the original manuscript and one copy; authors should keep another copy for reference. Type double spaced, including references, and leave margins of at least 3 cm (one inch). Supply a short title for running headlines. Spelling should conform to Webster's *Third New International Dictionary*, unabridged edition, 1971. Nomenclature used in descriptive human anatomy should conform to *Nomina Anatomica*, 5th ed, 1983; the terms 'canine', 'premolar', and 'facial' are preferred but 'cuspid', 'bicuspid', and 'labial' and 'buccal' are acceptable. SI (Système International) units are preferred for scientific measurement but traditional units are acceptable. Proprietary names of equipment, instruments, and materials should be followed in parentheses by the name and address of the source or manufacturer. The editor reserves the right to make literary corrections.

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