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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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EDITORIAL

Who Should Pay?

Paying for a commodity is always a necessary though not the most enjoyable part of the transaction. Frequently the payment can be postponed, as by the use of a credit card, but the day of reckoning inevitably arrives. Sometimes someone else, an employer, for example, can make the payment for us, as with dental insurance, or prepaid dentistry, but we pay nevertheless.

One type of payment for which there is almost universal distaste is payment of a tax, especially a tax on income. To evade such payments we resort to tax shelters and loopholes. One of these loopholes, a relic of wartime controls on prices and wages, is to accept part of our wages or salary in the form of a commodity, which is free of tax, rather than in money, for example, prepaid dental treatment. This method of payment, however, usually involves coercion —coercion of those that would like to make their own arrangements and prefer the money instead. Having paid in advance for the treatment the incentive is usually to get as much as possible in return. This has led to an artificially induced increase in demand, which is part of the cause of the unexpectedly high costs of medical and dental treatment that have created financial difficulties for Medicaid and Medicare.

Another way to avoid paying directly for something is to demand it from the government as a right. Groups with special interests that are well organized can often persuade the government, through lobbying, to benefit them through subsidies, tariffs, quotas, or by other means. These benefits, however, can be obtained only at the expense of all the other members of society. Such a situation was perceived long ago by a French economist of the nineteenth century, Frederic Bastiat, who defined the state as "the great fictitious entity by which everyone seeks to live at the expense of everyone else."

The more the state provides for us, the more we can spend on things that give us immediate pleasure. The problem with applying this philosophy to medicine, for example, has been well stated by Lee: "A curious paradox of some contemporary social philosophy is the idea that a man should spend what he earns for his pleasures rather than for what he needs. It is appropriate, so the reasoning goes, that he should buy a television set, a vacation in Florida or an outboard motorboat, because these are cardinal rights. But for something that he really needs, such as his life or his health, or the life of his child, someone else should pay. This may be the Government, his employer, his union, his great-aunt or anyone else who can be cajoled or coerced into paying the price for him. If no one else will pay for it, the doctor should serve him for nothing. This is the philosophy of the child, whose needs should be met by his parents but whose Christmas money or earnings for sweeping the front porch should be spent on his personal pleasures. This may be acceptable for the child of an indulgent parent, but it is not appropriate for a free man in a free society. It makes of him less of a man and more of a dependent child; yet some seem to consider this one of their rights."

In looking to the state, or to other third parties, to provide us with goods and services we exchange independence for security, and, judging from the recent concern about the financial health of Social Security, Medicaid, and Medicare, a security that in the end may elude us. Moreover, to relinquish individual responsibility is to face the prospect of living ultimately in a nursery or even worse—a prison.

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ORIGINAL ARTICLES

Hydroxyapatite Attached by Laser: A Potential Sealant for Pits and Fissures

A compound of hydroxyapatite can be attached to enamel by means of a laser at temperatures that should not damage either enamel or pulp.

L STEWART • G L POWELL
S WRIGHT

Summary

A synthetic hydroxyapatite compound, formed by combining hydroxyapatite with a low-fusing eutectic, was successfully attached to the enamel of extracted teeth by means of a carbon dioxide laser. This technique has potential for sealing pits and fissures.

Introduction

The potential usefulness and desirability of a durable sealant for pits and fissures are widely recognized. Currently available sealants composed of a matrix or organic resin are highly effective while intact but their lifetimes are variable. (Bagramian, Srivastava & Graves, 1969; Mertz-Fairhurst & others, 1982). One possible reason for the variation in durability may be the differing coefficients of thermal expansion of sealant and enamel of teeth, while another may be the lack of a chemical bond between sealant and enamel. Since tooth enamel is largely inorganic, being approximately 96% hydroxyapatite, a sealant composed of hydroxyapatite should have good durability if it could be applied effectively to enamel.

To be effective and useful a sealant must be attached without damaging the tooth. Studies of hydroxyapatite indicate that temperatures of 1000 - 1200 °C for one to three hours are necessary for sintering (Jarcho & others, 1976; Rao & Boehm, 1974). To achieve these temperatures in the mouth a source of heat of very high intensity must be used. One possible source of such high intensity is a laser. Several workers have attempted to fire hydroxyapatite or other

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restorative materials to the tooth with a laser but have been unsuccessful with high densities of energy (Lobene, Bhussry & Fine, 1968). Densities of energy in excess of 23.5 joules per square centimeter, however, produce microcracking of the surface of enamel (Boehm & others, 1977). Temperatures of less than 1000 °C and of short duration applied at occlusal surfaces and rises of less than 5 °C in the temperature of the pulp, however, cause no pulpal damage (Boehm, Chen & Blair, 1975; Zach & Cohen, 1965). Recently we have developed techniques whereby we can safely and effectively sinter a synthetic compound of hydroxyapatite to the tooth with a carbon dioxide laser.

Methods and Materials

A continuous wave carbon dioxide laser, Sylvania model 950 (Line Lite Laser Corp, Mountain View, CA 94039, USA), mounted on a bench, and a carbon dioxide surgical laser, Cavitron model 300 (Cooper Lasersonics, Inc, Santa Clara, CA 95051, USA) with an articulated arm, were used in these experiments. A carbon dioxide laser was used because it was anticipated that its characteristic wavelength of 10.6 nm would be highly absorbed by tooth enamel since this wavelength should be near the peak of optical absorption for enamel (Stern, Vahl & Sognnaes, 1972). Furthermore, since the hydroxyapatite compound is very similar to tooth enamel in composition one would expect a good match of thermal, mechanical, and chemical properties, which would seem to lessen the likelihood of the hydroxyapatite compound being removed by thermal stresses. Densities of laser energy are defined as joules per square centimeter ($J\ cm^{-2}$) (watts x time per area).

The hydroxyapatite used in this study was synthesized by a method similar to that reported by Jarcho and others (1976), with the addition of a eutectic of a fluoride compound (LiF, MgF_2 & CaF_2) to lower the time and temperature for the sintering of the hydroxyapatite. The eutectic was prepared by melting the mixed fluoride materials at 700 - 900 °C, pouring them while still liquid onto a stainless steel plate, allowing them to cool, and then grinding them to a 200 mesh. The eutectic was then added to the hydroxyapatite in a proportion by weight of 30% eutectic to 70% hydroxyapatite to form the hydroxyapatite compound, referred to as HAP (patent pending). The powdered HAP compound was resuspended in either ethanol or water and applied to the enamel of extracted teeth with the aid of an airbrush.

Before the HAP compound was applied, the teeth were cleaned, etched with acid, rinsed, and dried with air. They were mounted on a belt that could be rotated at speeds of 12 - 13 cm s^{-1} through the spray of the airbrush (thickness of the compound could be varied by applying multiple coats), allowing the material to dry before firing with the laser. The thin coat of HAP compound was lased using 21 - 316 J cm^{-2} (1.5 - 3.0 W at times of 0.125 - 1.0 s and a beam size of 9.5 x $10^{-3}cm^2$ at the focal point). The teeth were moved through the laser beam allowing for a line of the material to be sintered. They were then prepared for thermal cycling and tests for penetration of dye. In applying the HAP compound to the occlusal surface, the teeth were cleaned and etched with acid. A thin coat of the HAP was applied with the airbrush, allowed to dry, and the laser energy delivered through a hand-held nozzle in minimal overlapping patterns. Following this application the teeth were examined for damage (cracking of enamel) and adherence of the compound.

After firing with the laser, the teeth were subjected to thermal cycling and penetration of dye. For thermal cycling the teeth were mounted on an automatic device that cycled them between two streams of water at different temperatures for a period of 25 seconds each. One stream was maintained at 15 $\pm$ 2 °C, the other at 45 $\pm$ 2 °C, resulting in a temperature differential of 30 °C. These temperatures were used because a previous study had shown that these are the normal limits of temperature occurring in the mouth during ingestion of food (Peterson, Phillips & Swartz, 1966). To test for the penetration of dye, teeth whose pulp cavities had been sealed off with epoxy cement were placed for 24 hours in a fluorescent dye (Zyglow), which is visible under ultraviolet light (Boehm & others, 1977). The teeth were then sectioned and examined under ultraviolet light and magnification for cracking of enamel as evidenced by penetration of the enamel surface by the dye.

Results

HAP compound can be attached to the enamel of extracted human teeth, including the occlusal surface, with a carbon dioxide laser using densities of energy from 21 to 316 J cm^{-2} (Figs 1 & 2). During sintering at densities of 24 J cm^{-2} or less the enamel did not crack, the compound was neither removed nor affected by thermal cycling, and there was no apparent damage to the enamel or tooth.

FIG 1. *Hydroxyapatite compound attached to facial surface of extracted tooth (black dot is location reference marker)*

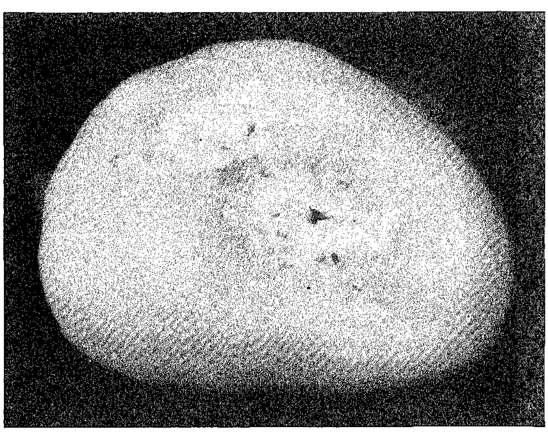

FIG 2. *Hydroxyapatite compound attached to occlusal surface of extracted tooth*

Although hundreds of teeth were used in the experiments, the results are summarized through representative samples in the accompanying tables. Tests for penetration of dye show that at high densities of energy the dye had penetrated into the enamel of most samples (Table 1); however, this disappeared at the lower densities with little or no penetration of dye. Thermal cycling had no effect on either the appearance of the fired material (Table 2) or the extent of penetration of the dye, and the HAP compound remained attached.

Table 1. Penetration of Dye as a Measure of Microcracking of Enamel

Energy J cm^{-2}	Penetration of Dye
316	penetration
211	penetration
158	penetration
79	penetration
24	no penetration
21	no penetration

Table 2. Change in Appearance or Attachment of Hydroxyapatite Compound after Thermal Cycling

Number of Tooth	350 Cycles	600 Cycles	850 Cycles
228	no change		no change
262	no change		no change
288	no change		no change
388	no change		no change
403		no change	
407		no change	
411		no change	
419		no change	

Discussion

The results indicate that with the addition of a low-melting eutectic the sintering temperature of hydroxyapatite can be lowered to the range of 300 - 500 °C. A synthetic hydroxyapatite can be successfully sintered by laser to the enamel of extracted teeth by means of a wide range of density of energy and can be done within the prescribed range of biological safety — less than 1000 °C of temperature at the surface of enamel, less than 23.5 J cm^{-2} of density of energy, and without anticipated damage to the pulp or enamel.

The results of the tests for penetration of dye seem to corroborate previous findings that high densities of energy tend to produce microcracking of the surface of the enamel. It was observed that at the higher levels of energy, penetration of dye was seen on most samples; however, at densities of energy near or below the threshold for cracking of enamel penetration of dye does not seem to occur. Since the HAP compound could be sintered at levels of energy near or below the theoretical threshold for cracking enamel this would seem to present little or no problem in the effective use of the compound.

The use of an articulated arm to deliver the beam of the carbon dioxide laser allows greater maneuverability than the bench laser or binocular microscope and more closely resembles the conditions that would be necessary for effective use on teeth in the oral cavity. Development of a fiberoptic system for delivering the continuous wave carbon dioxide laser would greatly enhance the potential clinical use.

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Ability to Evaluate Nonvisible Margins with an Explorer

Limited access to the margin did not
affect the size of marginal discrepancy accepted

H W DEDMON

Summary

When experienced dental faculty used an explorer to evaluate nonvisible margins on a device made to simulate gradations in two types of discrepancy frequently found when fitting dental castings (vertically open and overhanging), there was significant inconsistency among members of the faculty as to the maximum discrepancy acceptable.

When physical access to the margin was limited (simulating a subgingival interproximal margin), evaluation of the margins varied more than when access was unlimited (simulating a supragingival facial margin). Limiting access to the margin did not significantly affect the mean size of discrepancy accepted.

The sizes accepted for the two types of discrepancy differed significantly, the range of sizes accepted for vertically open margins being 27-72 μm and for overhanging margins 3-39 μm.

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Introduction

Most dentists evaluate the margins of castings intraorally with an explorer before cementing them. Margins of restorations are often not visible and, moreover, physical access to margins may be limited due to subgingival preparation and the proximity of adjacent teeth. Under these conditions the dentist must rely upon his tactile sense.

Effects of visibility on the ability to evaluate margins have been reported. Christensen (1966) reported that experienced restorative dentists using an explorer to evaluate the margins of inlays cemented in extracted teeth were less consistent and accepted larger discrepancies when the margins were not visible than when they were visible. A recent study (Dedmon, 1982) reported that when experienced dental faculty, using an explorer and with eyes closed, evaluated margins before cementation they were even less consistent and accepted much larger discrepancies than those reported by Christensen (1966).

Limited physical access to the margin may also impair the dentist's tactile sense but the effects of limited access on the ability to evaluate the margins of castings with an explorer have not been reported.

The purpose of the present study was to determine the effects of limited physical access on the ability of experienced dentists to evaluate nonvisible margins with an explorer.

Method

A hardened steel instrument was designed and machined to provide a continuous margin of 90° along two sides of a rectangular block (Fig 1). By placing spacers between parts of the device and creating inclined planes, dimensions of the discrepancy of the margins were made to change continuously at rate of 3 μm mm^{-1} of length along each margin. One side was adjusted to create a vertically open margin simulating an incompletely seated casting; the other side was adjusted to create an overhang with no opening.

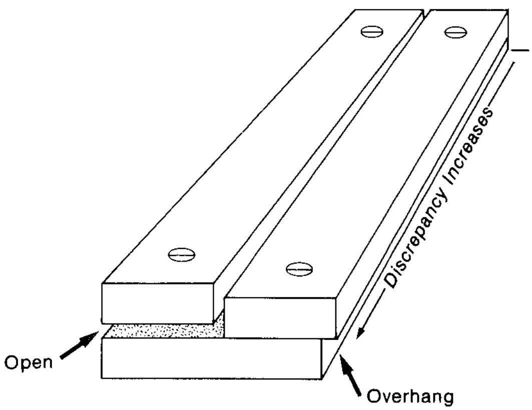

FIG 1. *End view of instrument*

So that the subject could evaluate the margins with an explorer with his eyes open and yet not see the margins, a metal shield was constructed to cover the metal block. An opening in the shield provided unlimited access for the explorer to the margin. The size of the discrepancy could be increased or decreased by moving the metal block to the right or left beneath the shield. The type of discrepancy could be changed by placing the shield to expose the other side of the block (Fig 2).

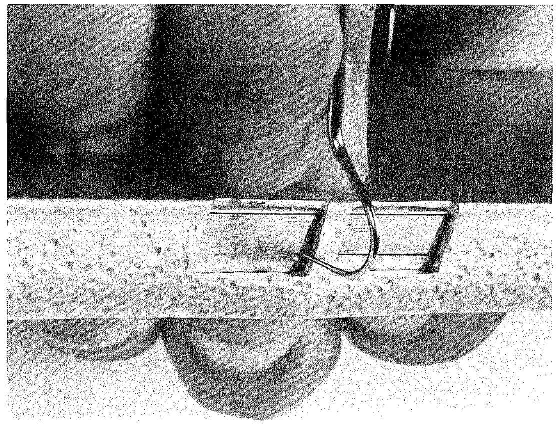

FIG 2. *Evaluation of margin with unlimited access*

A vertical bar 3 mm wide crossed the opening to simulate an adjacent tooth. With a rubber band covering the margin, subjects could be instructed to evaluate the margin beneath the band and the bar simultaneously, simulating the limited access of an interproximal margin that was approximately 1 mm beneath the gingiva (Fig 3). Equal access was provided on each side of the bar to accommodate right- and left-handed subjects. The bar was also used to locate the position of the tip of the explorer along the margins when access was unlimited (Fig 2).

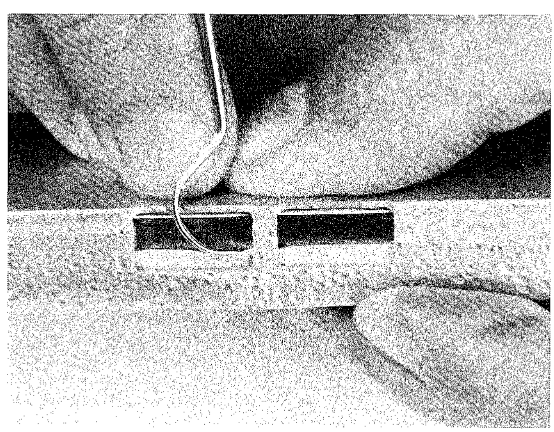

FIG 3. *Evaluation of margin with limited access*

A millimeter scale attached parallel to each margin could be viewed by uncovering a window in the shield after the subject indicated that the largest discrepancy he would accept had been reached (Fig 4). A pointer in the window allowed immediate determination of the distance of any point along the margin from the zero end of the instrument. All distances from the zero end of the instrument were rounded to the nearest millimeter. The dimension of the discrepancy at any point along the margin could be determined by multiplying its distance from the zero end of the instrument by three. For example, if the largest discrepancy the subject would accept before cementation was 20 mm from the zero end of the instrument, the dimension of the discrepancy was 60 μm.

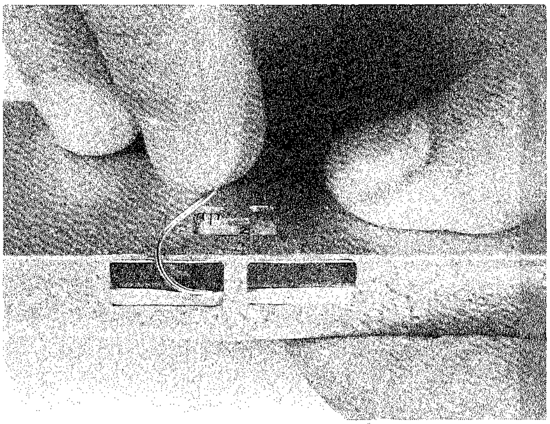

FIG 4. *Window with pointer on millimeter scale*

Six subjects were chosen. Two were chairmen or former chairmen of departments of fixed prosthodontics. Two were board certified in fixed prosthodontics. The remaining four were eligible for the board in fixed prosthodontics. All subjects had three or more years experience practicing and teaching clinical fixed prosthodontics.

During each trial, each subject evaluated the margin by feeling it with an explorer. Starting at the zero end of the instrument, the dimension of the discrepancy of the margin was gradually increased by moving the metal block beneath the shield until the subject indicated that the largest discrepancy acceptable had been reached. The subject was then asked to choose one of five possible descriptions of the discrepancy. The choices were: (1) ledge, (2) overhang, (3) vertically open, (4) ledge and open, (5) overhang and open. The size and description of the discrepancy were then recorded.

With unlimited access (Fig 2), 10 trials were recorded for each subject, five for each type of margin. Seven or more days later a second set of 10 trials was recorded in the same manner except that access to the margin was limited, simulating an interproximal margin approximately 1 mm beneath the gingiva (Fig 3). Alternation of the type of margin was randomized during both sets of trials. During all trials, all subjects used the same new Tarno explorer (S S White Dental Products International, Philadelphia, PA 19102, USA), which they agreed was sharp.

The recorded data were analyzed statistically using Duncan's multiple range test to determine how the order of the trials affected the results. This test also was used to determine the significance of the differences among subjects for both types of margin, between types of margin, and between types of access to the margin. Analysis of the components of the variances was used as a test for reliability within subjects.

Results

Figure 5 shows the individual ranges and means for each type of margin with each type of access, the mean for each type of margin with both types of access combined, and the combined mean for both types of margin with both types of access combined.

The mean for overhanging margins with both types of access combined was 14 μm compared with 53 μm for open margins. The combined mean for both types of margin with both types of access was 33 μm.

Duncan's multiple range test revealed that differences in access to the margin had no effect on the mean size of discrepancy accepted nor did the order in which the trials occurred ($P < 0.05$). The same test revealed statistically significant differences among subjects for both types of margin and between types of margin ($P < 0.01$).

As a test for reliability within subjects, analysis of the components of the variance revealed that on open margins when access was unlim-

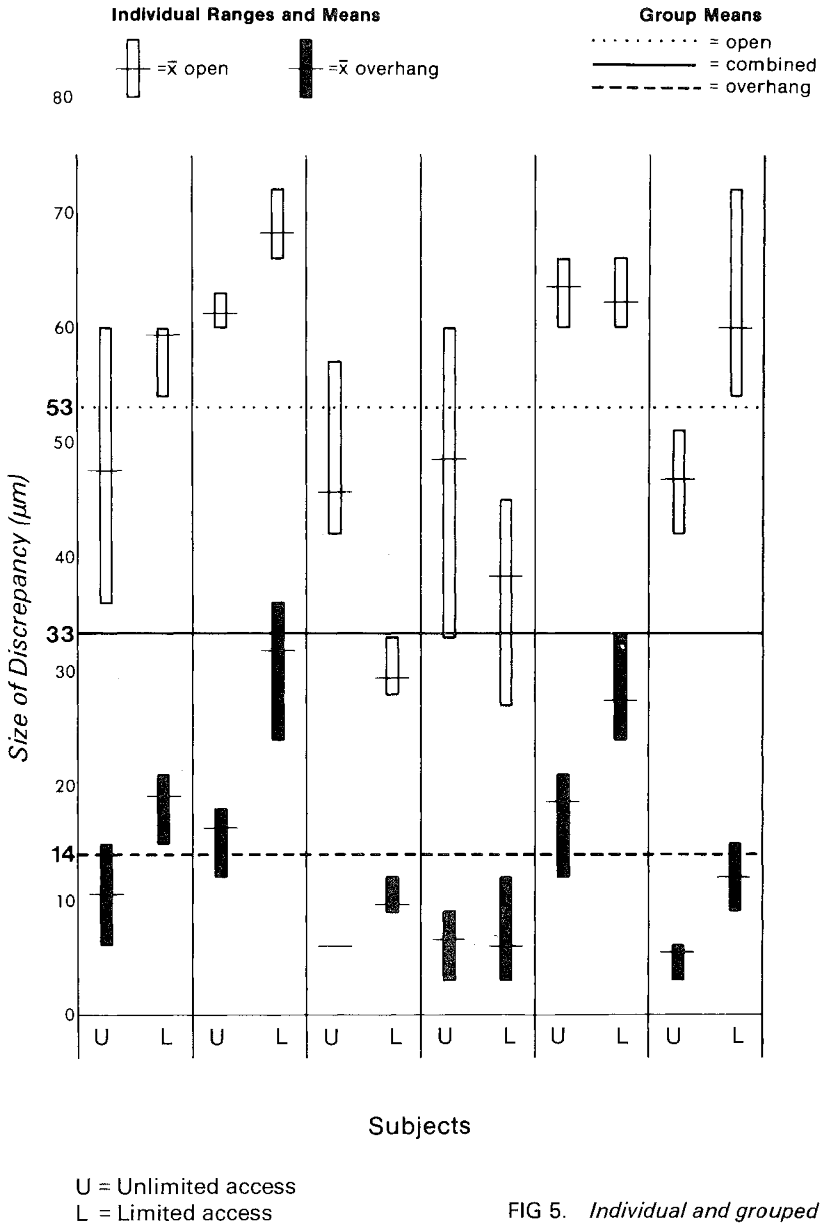

FIG 5. *Individual and grouped results of trials*

ited 82% of the variation was due to differences among subjects and 18% to differences within subjects, whereas, when access was limited, 90% of the variation was due to differences among subjects and 10% to differences within subjects. On overhanging margins with unlimited access, 51% of the variation was due to differences among subjects and 49% to differences within subjects. When access was limited on overhanging margins, 90% of the variation was due to differences among subjects and 10% to variation within subjects.

The table shows numbers, types, and percentages of errors recorded when subjects described the type of margin being felt on each trial.

Discussion

The relationship between rate of failure and width of cement line for dental castings has not been established by definitive clinical studies. A laboratory study has shown that the thickness of the cement layer may affect the speed of disintegration of cement (Mesu, 1982). However, there is general agreement that it is desirable to have margins closed as much as possible to minimize the width of the cement line.

In the present study, the mean size of discrepancy accepted for open margins before cementation was 53 μm. Castings are usually elevated an additional 20 μm or more after cementation (Eames & others, 1978). If 20 μm were added to the mean of 53 μm for open margins, the result would be almost identical with the mean width of 74 μm for the cement line reported by Christensen (1966) when dentists rated nonvisible margins of inlays cemented in extracted teeth.

The mean size of overhangs accepted in this study was 14 μm before cementation. Therefore, overhanging margins, if they are closed, need not be visible to be rejected below the 39 μm suggested by Christensen (1966) as the level of acceptance for visible margins.

In a previous study, Dedmon (1982) reported that the mean size of discrepancy accepted was 93 μm for overhangs and 114 μm for openings when dentists evaluated margins with their eyes closed. When evaluating nonvisible margins in the present study, the ability to see the explorer and its movement in relation to the margin was apparently an important factor in reducing the mean size of discrepancy accepted. Observations of the subjects' behavior during the trials support this opinion. All subjects viewed the explorer intently until they had established the best available angle of approach to the margin. They then looked away and felt the margin. They occasionally looked again at the instrument, presumably to be sure the angle had not changed.

Surprisingly, limiting access to the margin did not cause significant changes in the mean size of discrepancy accepted. When questioned, all subjects believed they were accepting larger discrepancies and admitted to more guessing when describing those discrepancies examined with limited access. Variation due to differences among subjects did increase for both types of margin, while errors in describing the discrepancies increased for overhangs and decreased for openings when access was limited (see table).

Errors in Describing Margins

	Access	Correct		Incorrect	
	n=30	n	%	n	%
OPEN	Unlimited	12	40	18	60
	Limited	15	50	15	50
OVERHANG	Unlimited	30	100	0	0
	Limited	20	67	10	33

No more than 50% of the open margins were correctly described, regardless of the access available. Openings were most often erroneously perceived as ledges and overhangs. These findings are similar to those of the previous study described above (Dedmon, 1982) in which dentists evaluated margins with their eyes closed.

The results of the present study indicate that when margins are not visible, discrepancies resulting from incomplete seating of castings are the most difficult to detect with an explorer and larger-than-desirable openings are likely to be accepted before cementation. Even with the most careful laboratory procedures, castings often do not seat completely on the prepared teeth (Fusayama & others, 1963; Eames & others, 1978).

Conclusions

- When identifying acceptable discrepancies of nonvisible margins with an explorer, experienced dentists differ within and among them, regardless of the degree of physical access to the margin.

- Disagreement among dentists increases

when physical access to nonvisible margins is limited.

- When physical access to nonvisible margins is limited, the average size of discrepancy accepted is not significantly changed.

- Significantly larger discrepancies are accepted when nonvisible open margins occur due to incompletely seated castings than when overhangs are present.

- When margins are not visible, more reliable methods are needed to detect and evaluate—before cementation—the degree to which castings are seated.

(Accepted 28 February 1984)

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Strength of Tray Adhesives for Elastomeric Impression Materials

The tensile strength and shear strength of adhesives vary among brands. A weak bond may lead to an inaccurate impression.

J W NICHOLSON • K H PORTER
TERESA DOLAN

Summary

Samples of different types of elastomeric impression materials that had been attached to acrylic by their respective adhesives were tested for tensile and shear strength. The strongest adhesive in tension was provided by a polyether, Impregum, which had the second strongest adhesion in shear. Mirror, an addition silicone, had the strongest adhesion in shear and the second strongest in tension. Reflect, an addition silicone, had the weakest adhesion in shear but the strength of its adhesion in tension was similar to that of Permlastic, a polysulfide.

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Introduction

An important, often undiscussed, factor in the accuracy of elastomeric impression materials is the complete adhesion of the elastomer to the tray as the impression is removed from undercuts and oral structures. Weak or inadequate adhesion between elastomer and tray may result in undetected inaccuracies in impressions that contribute to ill-fitting restorations and costly makeovers.

Phillips (1982) and others (Clinical Research Associates, 1983) have noted that, in general, the adhesives for polysulfides, polyethers, and condensation silicones are satisfactory, whereas those used with addition silicones are less effective. Therefore, when using an addition silicone for impression material, the clinician has been cautioned to take additional precautions such as the use of custom trays, the creation of multiple holes for retention, and the use of heat cured trays painted with adhesive (Kerr Dental Products Division, 1979; 1981).

The purpose of this study was to compare the bond strengths of the adhesives for two addition silicones, one of which, Mirror (Kerr Dental Products Division, Romulus, MI 48174, USA), was said to provide an adhesive with improved properties, a polysulfide of regular viscosity, and a polyether. Davis, Moser and Brinsden

(1976) reported that the strength of the adhesive for conventional silicone was inferior to that of adhesives for both polysulfide and polyether materials when tested in tension. However, in clinical situations requiring an impression tray, Wilson and Smith (1963) noted that both tensile and shear forces stress the elastomer/tray interface as the impression tray is removed from the dental arch (Fig 1). They recommended that impression materials be tested for both the tensile and shear strengths of their respective adhesives.

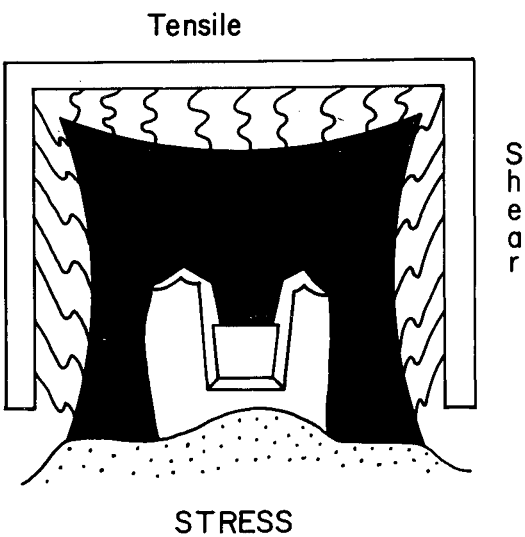

FIG 1. *Schematic representation of adhesive bond stress at elastomer/tray interface*

Materials and Methods

Four elastomeric impression materials with their specific adhesives as packaged for clinical use were selected: Reflect, an addition silicone (Kerr Dental Products Division), Mirror, a newer addition silicone (Kerr Dental Products Division), Permlastic, a polysulfide (Kerr Dental Products Division), and Impregum, a polyether (Premier Dental Products Co, Norristown PA 19404, USA).

For the tensile test, 10 pairs of acrylic blocks, one inch (2.54 cm) square, were formed of self-curing tray-resin (L D Caulk Division, Milford, DE 19963, USA) for each of the four impression materials. The test surface of each block was formed against a clean glass surface to provide uniformity and freedom from contamination. An acrylic fixture was constructed to ensure parallel approximation of the standardized acrylic blocks and to allow for a uniform thickness of 3 mm of impression material (Fig 2).

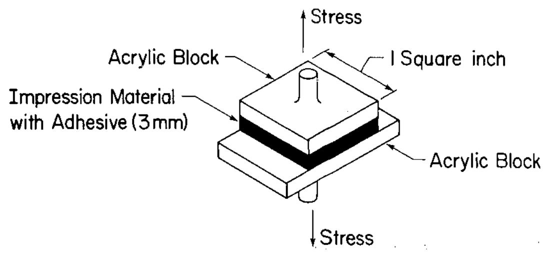

FIG 2. *Tensile specimen geometry*

The one-inch-square test surfaces were painted with the tray adhesive specified by the manufacturer for each impression material and allowed to dry in air for 15 minutes. All impression materials were proportioned by weight, mixed according to manufacturer's specifications by a double-spatula technique, and then applied to the adhesive covered blocks. After placing the squares of acrylic loaded with impression material in the spacer apparatus, each specimen was immediately placed in a water bath at 35 °C and allowed to set for 15 minutes. All manipulation of impression materials was based on the technique outlined in the American Dental Association Specification No 19 for elastomeric materials (American Dental Association, 1977). The specimen was then removed from the water bath and excess material trimmed with a sharp scalpel. Each specimen was aligned and gripped in the VEE grips of the Instron testing machine. Tension was applied at a constant cross-head speed of 50 mm min^{-1} and continued until separation occurred in either the adhesive or the impression material, or both.

For the shear test, 40 pairs (10 for each impression material) of acrylic slabs measuring 3 x 1 x 3/16 in (76.2 x 25.4 x 4.8 mm) were formed of self-curing tray-resin. The test surface of each slab was cured against a glass surface as above. At one end of each slab, a surface one-inch square was marked and designated as the test area for application of the adhesive. An acrylic fixture was constructed to allow parallel placement of the acrylic slabs and allow for a uniform thickness of 3 mm of impression material (Fig 3). The test area of

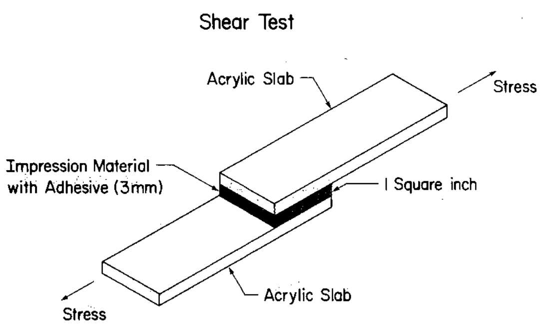

FIG 3. *Shear specimen geometry*

each pair of acrylic blocks was painted with the specified adhesive and the impression materials mixed, applied, and allowed to cure as before. Each specimen was vertically aligned and gripped in the "file face" grips of the Instron testing machine. Tension was applied at a constant rate of 50 mm min^{-1} and continued until separation or rupture occurred.

Results

The results are shown in Figure 4. Strengths of adhesive bond ranged from 44.3 to 309.0 lbf in^{-2} (0.3 - 2.1 MPa) in shear and from 167.5 to 435.4 lbf in^{-2} (1.2 - 3.0 MPa) in tension. In accord with previous reports, the adhesive for

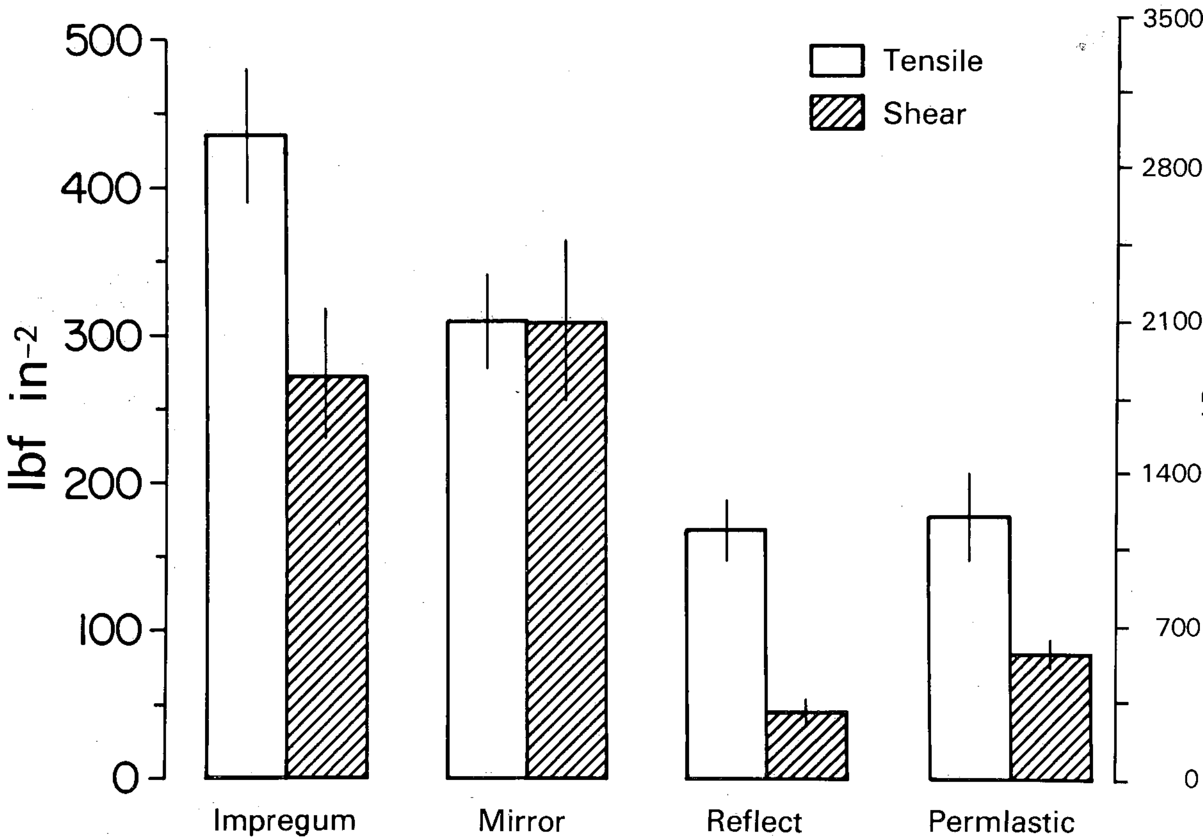

FIG 4. *Mean adhesive bond strengths of elastomeric impression materials to resin tray material*

the polyether material demonstrated the greatest tensile strength, 435.4 lbf in^{-2} (3.0 MPa), and very high values for shear strength. The adhesives for the two addition silicone materials demonstrated considerable differences in both tensile and shear strength. Although the materials are of approximately the same firmness when set, the stress required to rupture the adhesive for Reflect was a minimal 44.3 lbf in^{-2} (0.3 MPa) in shear, but the tensile strength was almost equal to that of the adhesive for the polysulfide, Permlastic. In contrast, the adhesive for Mirror, the newer addition silicone, had the highest shear strength as well as a very high tensile strength.

With the addition silicone materials, the rupture in adhesion usually occurred at the junction of adhesive and acrylic, with the adhesive remaining on the impression material, whereas with the polysulfide, the rupture in adhesion occurred between the adhesive and the impression material, with the adhesive remaining on the acrylic. The polyether demonstrated cohesive failure within the impression material, leaving pieces of fractured Impregum bonded to the acrylic blocks.

Discussion

The minimum strengths in shear and tension required to prevent rupture of the bond between elastomer and tray in clinical applications have not been established. However, clinical experience has shown that the adhesive for the polysulfide material, properly applied, is adequate for the typical intraoral impression with no excessive multiple undercuts or open gingival embrasures. The clinical significance of the shear strength for Reflect, which is about half that found for the polysulfide, is not known. One must, however, take into account the stiffness of the addition silicones and polyethers. With the greater flexibility of the polysulfide, it would be more easily removed from anatomical undercuts of the dental arch and presumably would put less stress on the adhesive bond securing the impression material to the tray. Therefore under the same clinical conditions, other more rigid impression materials, though their adhesives have bond strengths similar to that of polysulfide, may require modifications of the tray or adhesive technique to provide a clinically secure bond to the tray. The precautions and additional measures suggested for enhancing the retention of Reflect may be prudent insurance against a faulty impression.

This study does not support the blanket assertion that all adhesives for addition silicone elastomers are inferior to those for other impression materials. The adhesive for Mirror had the highest shear strength and, though the clinical significance is not known, equal strengths in both shear and tension. A dentist selecting an addition silicone material should take into account the difference in performance of adhesives included with this group of elastomers.

Conclusions

- The adhesive for Impregum, a polyether, had the highest tensile strength of the materials tested.

- The adhesive for Reflect, an addition silicone, demonstrated the lowest strength in both shear and tension.

- The adhesive for Mirror, an addition silicone, demonstrated the highest shear strength of all materials tested and was the only product to exhibit similar values of bond strength in both shear and tension.

- There was no apparent correlation between tensile strength and shear strength; however, the shear strengths were less than tensile strengths for all materials tested.

- The shear and tensile strengths of Mirror significantly exceeded those of the polysulfide, an established clinical standard.

- Further investigation is necessary to relate the effects of physical properties, filler content, and enhancements of techniques to develop standards for adhesive strengths that are clinically adequate for adhesives for elastomeric impression materials.

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Detailed Evaluation of Six Class 2 Amalgam Restorations

Defects and porosity were more frequent at the cervical than at the occlusal margins

IVAR A MJÖR • DENNIS C SMITH

Summary

Six class 2 amalgam restorations were analyzed macroscopically and microscopically. All occlusal surfaces were clinically satisfactory, but four of the six teeth exhibited defects on the approximal surface. Voids or crevices with and without evidence of secondary caries were observed. Porosity was more frequent at the periphery than in the bulk of the restoration. Inadequate condensation of the amalgam against the cavity wall seemed to be the main reason for the appearance of voids at the interface of tooth and restoration.

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INTRODUCTION

Studies of restorations that have failed may give valuable information about the etiology of failure (Healey & Phillips, 1949; Marshall, Jackson & Marshall, 1980; Mjör, 1981). Extracted teeth with restorations in situ as well as parts of, or whole, restorations that become available after clinical use are particularly suitable for assessment. Different techniques have been used to examine retrieved material, but interpretation of the data is often hampered by the fact that the previous history often is unknown as to operator, type of alloy, and period of observation.

The aim of the present study was to examine six class 2 amalgam restorations, all inserted by the same operator using the same brand of alloy and with known periods of observation.

MATERIALS AND METHODS

Six class 2 restorations in five deciduous teeth were available for study. They had all been inserted under rubber dam by the same operator using Dispersalloy. The observation period varied from 1 year and 4 months to 5 years and 2 months, with four of the restorations being in the range of 2 years and 1 month to 2 years and 7 months. The roots were either completely or partly resorbed and the teeth were extracted for this reason.

The teeth were examined macroscopically, then by optical stereo microscopy and scanning electron microscopy, especially at the interface of tooth and filling. They were then embedded in resin (Epofix, Struers), sectioned in selected planes, ground, and polished by means of standard metallographic techniques. The specimens were studied in the light microscope and in the scanning electron microscope (SEM) to assess the structure of the alloy adjacent to the tooth and the distribution of porosity.

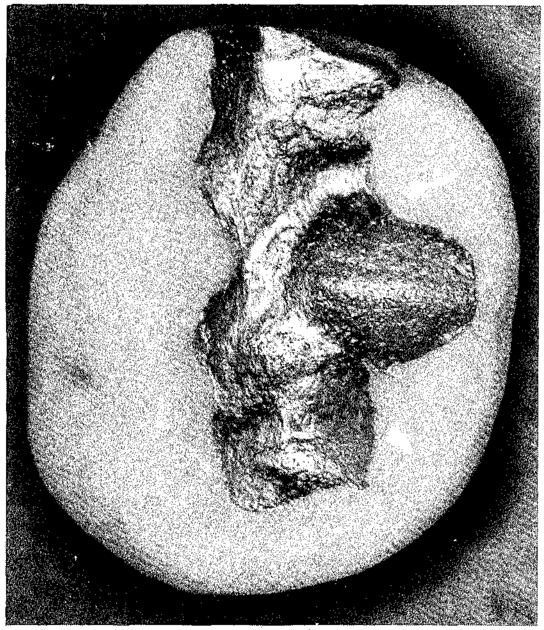

FIG 1. *Occusal view of a class 2 restoration that had been in situ for 2 years and 1 month. Note the slightly pitted surface and minimal degradation of the margin.*

RESULTS

Macroscopic Examination

Two teeth were cracked through the occlusal surface, but the pieces could easily be reassembled. The fillings were of average quality, slightly discolored, and with a somewhat pitted surface (Fig 1). The restoration with an observation period of more than five years was markedly discolored (Fig 2).

All occlusal surfaces appeared clinically satisfactory. However, four of the six teeth exhibited defects on the approximal surface, varying from typical secondary caries (Fig 3) to the presence of voids or crevices (Fig 4) and discoloration of a localized portion of the tooth adjacent to the restoration (Fig 5).

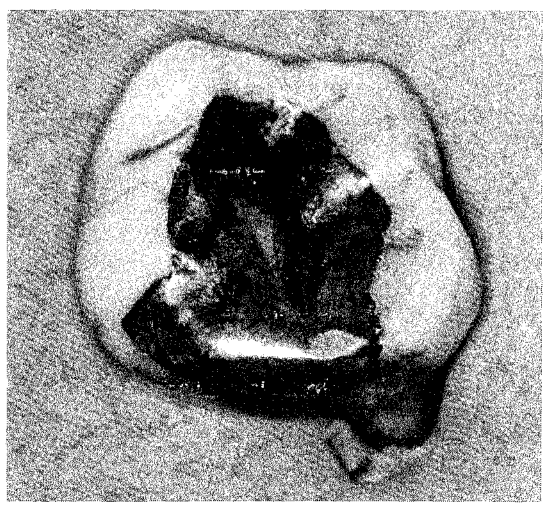

FIG 2. *Class 2 restoration that had been in situ for 5 years and 2 months. Note discolored (black) surface of the restoration.*

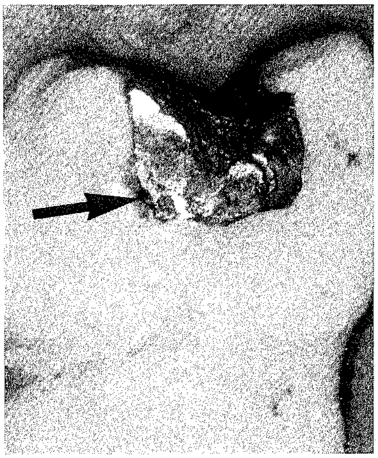

FIG 3. *Secondary caries (arrow) at the faciocervical corner of a class 2 restoration that had been in situ for 2 years and 1 month*

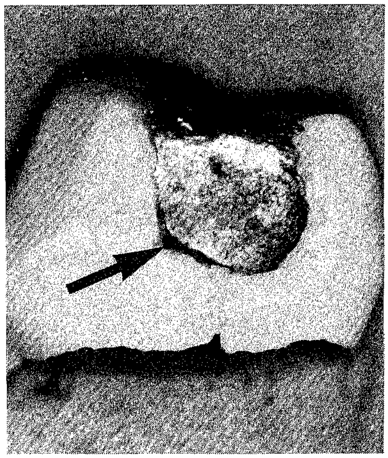

FIG 4. *Void or crevice (arrow) at the faciocervical corner without clinical evidence of secondary caries 2 years and 4 months after the restoration was inserted*

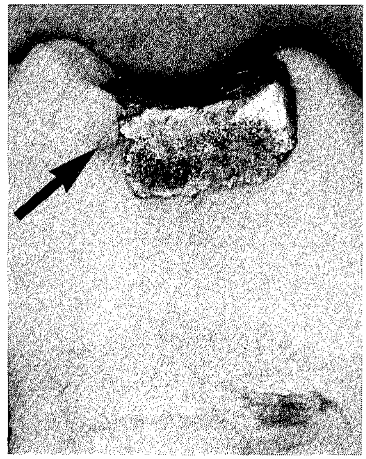

FIG 5. *Discoloration (arrow) at the lingual embrasure of a restoration that had been in situ for 2 years and 7 months*

Microscopic Examination

Voids or crevices at the interface of tooth and filling were commonly found, especially at the corners of the approximal box (Fig 6). The structure of the amalgam at these interfaces exhibited the characteristics of the individual particles of alloy (Fig 7) and extensive porosity in the adjacent areas. Generally, porosity was

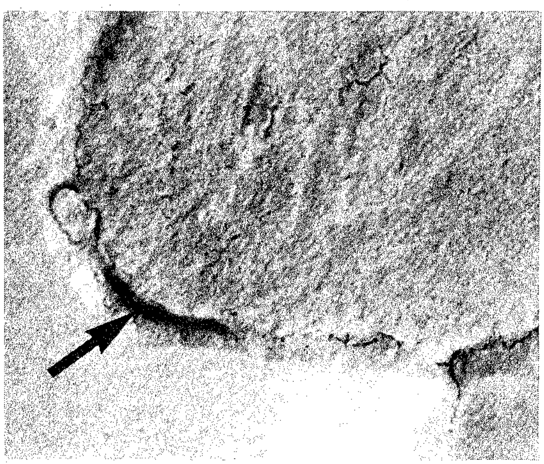

FIG 6. *Lingual corner of the restoration shown in Fig 5 viewed in the scanning electron microscope X30. Higher magnification of the crevice (arrow) is shown in Fig 7.*

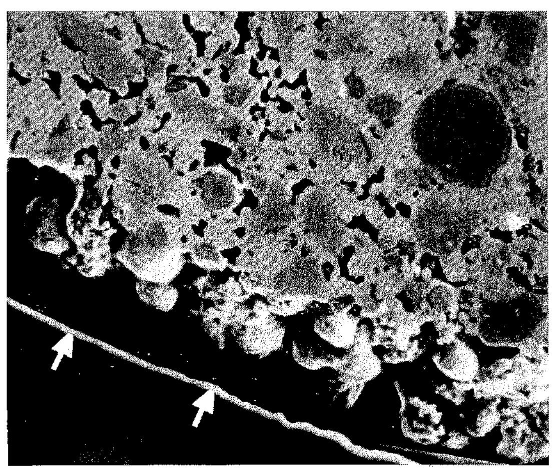

FIG 7. *Polished section through the crevice shown in Fig 6 viewed in the scanning electron microscope at X300. The typical structure of a dispersed type amalgam (Dispersalloy) is seen. Note that uncondensed particles of alloy are found adjacent to the crevice (arrows). The porosity (black areas) is also greater near the crevice than towards the bulk of the restoration.*

more frequent at the periphery of the restoration, that is, at the interface of tooth and filling, than in the bulk of the restoration (Fig 8). Any

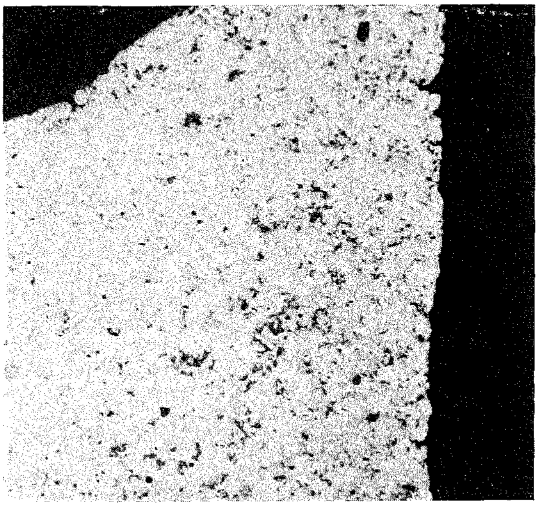

FIG 8. *Light microscopy of the interface of tooth and filling showing more porosity at the periphery of the restoration than towards the central part.*

irregularity of the cavity wall appeared to lead to a localized increased in porosity (Fig 9).

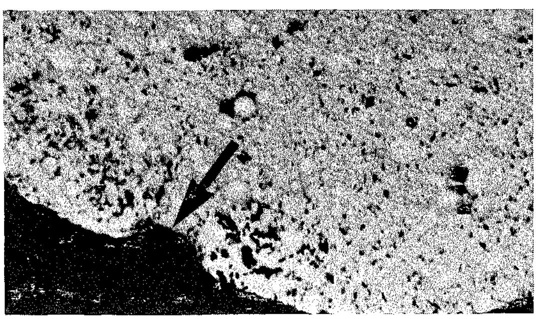

FIG 9. *Note increased porosity in the amalgam adjacent to an irregularity of the cavity wall (arrow) compared with those in the rest of the filling.*

DISCUSSION

Few definite conclusions can be drawn on the basis of the limited material studied. However, it is apparent that an examination of entire teeth gave different information than that obtained by inspection of occlusal surfaces alone. Thus the results demonstrate the limitation of the indirect techniques, for example, clinical photographs and replicas from impressions, where only the occlusal surface is available for assessment. Secondary caries, the major problem in operative dentistry (Healey & Phillips, 1949; Mjör, 1981; Mjör & Leinfelder, 1985), is missed in studies using indirect techniques only. On the other hand, when using direct techniques, that is, where the examination is carried out on the patient or on extracted teeth, all surfaces are available for evaluation, and thus more comprehensive information may be obtained and a more accurate diagnosis be made.

The diagnosis of secondary caries is difficult (Markén, 1962). It is likely that crevices may be recorded as secondary caries because the probe employed in the clinical examination tends to stick. However, crevices may be present without clinical signs of secondary caries, which may be defined as softened, discolored tooth structure adjoining a restoration that has developed some time after the restoration was inserted. The diagnosis of true secondary caries is especially hard at the cervical margin where direct observation may be impossible. Thus, a clinical diagnosis of secondary caries may encompass any crevice at the interface of tooth and restoration.

The reason for the presence of a crevice between the restoration and the cavity wall is difficult to ascertain on dry teeth. Apart from the desiccation, the crevices could result from inadequate condensation, or from destruction of the enamel during condensation and polishing, or from contraction of the amalgam during setting (Øilo, 1976). Considering that the crevices were not predominantly on the occlusal surface and limited largely to the cervical area, the setting properties of the material would seem to have no effect on the formation of the observed crevices. Also the alloy used exhibits minimal dimensional changes during setting. It is also unlikely that any effect on the enamel during condensation or polishing should be limited to the cervical areas. In addition, the structure of the amalgam adjacent to the crevices strongly indicated that the alloy had never been condensed against the cavity wall (Fig 7). It must be assumed that such crevices may predispose to secondary caries, especially as they are present in areas that are hard to clean. Therefore, the importance of proper condensation of amalgam restorations must be emphasized.

The distribution of porosity was assessed only qualitatively, but it was apparent that the central parts of the restorations exhibited less porosity than the peripheral parts. Any irregularity of the cavity wall apparently leads to an increase in porosity. These observations also point to localized difficulties in condensation which may be important for optimal clinical results. Studies on the effect of pressure of condensation on the degree of porosity indicate that a higher pressure of condensation leads to less porosity than a lower pressure, but with distinct differences in effect depending upon the amalgam used (Ekstrand, Jørgensen & Holland, 1985). Preliminary data from studies of tooth and filling to evaluate the frequency and extent of crevices at the interface of tooth and filling and of porosity of amalgam restorations that have been inserted a few days prior to extraction substantiate that crevices at the interface of tooth and restoration are common in the cervical area and that amalgam inadequately condensed against the cavity wall is relatively frequent in these locations (Ekstrand & Mjör, unpublished).

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DENTAL PRACTICE

Advantages and Disadvantages of Direct Gold Restorations

LAWRENCE L CLARK

Whenever we speak of the advantages of direct gold for restorations the quotes go back as far as G V Black. Standard replies to the question of advantages are: it is conservative; it is durable; it is kind to the tissues; it has the finest margins. Perhaps some other advantages to consider are those that would interest dental students. For example, direct gold: (1) can be handled by any student that wishes to perform a good service; (2) exposes students to excellence; (3) fine tunes the manual dexterity of the dental student; (4) can be placed using hand pressure, when powdered gold is used, with little or no pulpal insult or discomfort for the patient; (5) allows the operator to attain the self-satisfaction for which we all strive as a reward for our efforts. We could show the students how useful direct gold can be for repairing carious crowns or abutments (Fig 1) and how satisfying it is to see a mouth

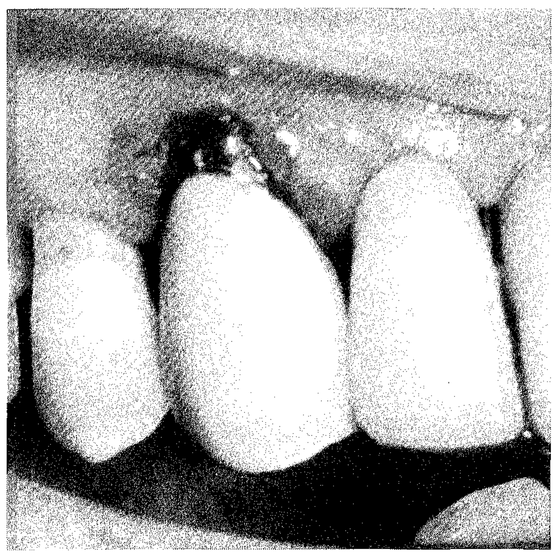

FIG 1. *Canine abutment—class 5; caries restored with direct gold*

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From a symposium "Why Bother Continuing to Use an Outdated Restorative Material like Direct Gold?" presented at the annual meeting of the American Academy of Gold Foil Operators, 19 October 1984, in Atlanta

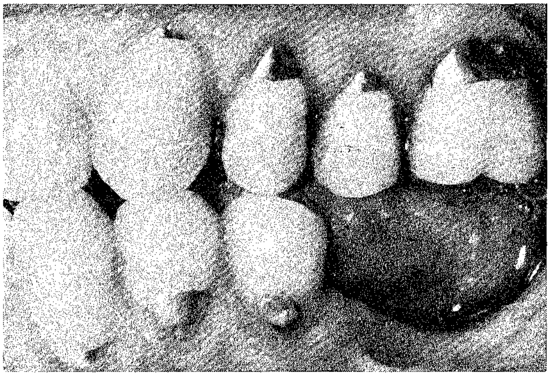

FIG 2. *Six direct gold restorations and one amalgam (direct gold by Capt Glenn E Gordon, DC, USN)*

that has been restored with this material (Fig 2).

The statement by Hollenback (1962) about taking a conservative approach in dentistry and ultimately giving a better service is an advantage that we rarely discuss with nonbelievers. We do not rebut our critics with the advantages of the sterility of gold foil and its antibacterial action (Smith, 1957); or the histological evidence of the minimal effect on the pulp by the condensation of gold foil (Thomas, Stanley & Gilmore, 1969).

Certainly, no one disagrees with these statements. However, maybe we should spend more time on the advantages that seem to concern most dentists today, **Time and Money**. Ingraham and Koser (1961) mentioned in the introduction to their text that "Gold foil can become one of the most practical, profitable and pleasurable parts of a dental practice." As you think about that quotation, I want you to try to remember if anyone ever mentioned it during your school years. Why don't we tell our colleagues how practical direct gold restorations are in a general practice? Why don't we emphasize the one-visit restoration with the finest material available in dentistry? Why don't we talk about the amount of money that can be made placing direct gold restorations? Most of all, why don't we talk about how great it feels to place a good direct gold restoration? If I had to answer these questions it would be difficult, because I didn't grow up in the marketplace of dental economics where everything is a commodity.

The advantages of direct gold are many but the use is little. Are the disadvantages of the restoration more than we care to admit? After all, it has been said that beauty is in the eyes of the beholder; maybe we have tunnel vision.

Let's consider some of the disadvantages of the gold foil restoration. According to Coy (1957) there are only three minor disadvantages: color, thermal conductivity, and difficulty of manipulation. If these are the only disadvantages then why are fewer and fewer gold foil restorations being placed? Some dentists say that with the cost of gold today the restoration is not economical to accomplish. Stibbs (1980) says that this is not true, even if the cost of gold were to reach $700 an ounce. Others say that esthetics is a big concern and therefore color is a major disadvantage and not a minor one. Certainly we can agree that esthetics is important, but we must admit that it is not a reason to bury gold foil completely. Many incipient occlusal lesions and pits, on adults and adolescents, can be restored with foil and still leave an esthetic appearance. Class 3 lesions can be restored by means of a lingual approach and not change the esthetics (Fig 3). Also, class 5

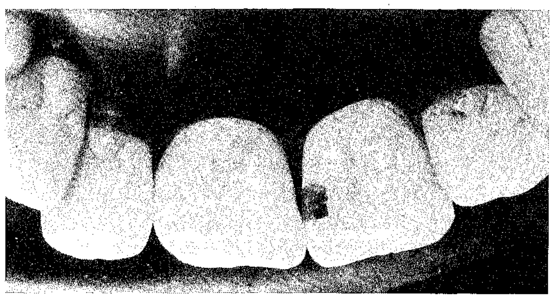

FIG 3. *Class 3 direct gold restoration on the mesiolingual of the maxillary right central incisor—lingual view*

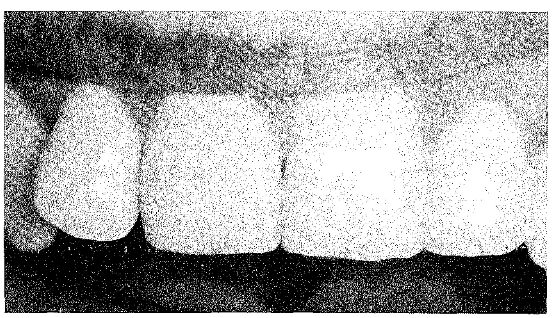

FIG 3A. *Facial view*

lesions that are minimal can be kept conservative and esthetically acceptable (Fig 4).

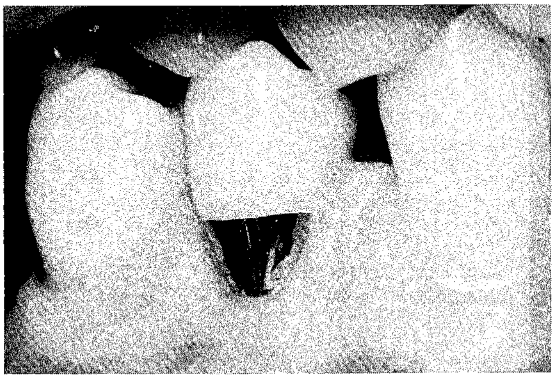

FIG 4. *Class 5 direct gold restoration on the mandibular right first premolar*

As I continue to think about it, I have difficulty understanding why these few so-called disadvantages are placing the gold foil restoration among the obsolete. Maybe there is another reason. Maybe we have overlooked the biggest disadvantage of the gold foil restoration. "Ourselves."

For years, before my dental career as well as after, the gold foil restoration was placed on a pedestal of excellence that only a few could reach. When gold foil was discussed by our dental materials teachers they always made it a point to tell you how technic sensitive it was and that there was nothing worse than a poorly placed gold foil restoration. We would condense our foil into a cavity prepared in an ivorine block, finish and polish it, and then cut it out so we could see all of our faults; not so we could see what was good, only what was bad. Then we would move on to our course in operative dentistry. Here we learned the Black's, Ferrier's, and Woodbury's preparations, which in the early days were by no means conservative. Now I'm not saying that conservative preparations weren't being used in the early 1960s; I am saying, however, that they weren't being taught out of dental school textbooks. Dental schools were teaching the larger preparations with acute angles and minimal retention.

How many times, while you were in school, did that triangular bar take you an hour or more to get started? Then halfway through your condensation, due to a slight misdirection of your condenser, everything you had placed came out. This never happened to you? You were either very lucky or very good. Most students lived in fear of placing any gold foil beyond a pit or small class 1 occlusal. It seemed as if every instructor was waiting for you to place a class 3 or class 5 gold foil, just so he could find porosity or try to pull the restoration out of the cavity. The gold foil restoration became the measure of your ability as an operative dentist. Although you wanted to be a good operative dentist, you would always worry when your schedule showed a foil patient coming up. There was no enjoyment on that day.

I don't want to give you the impression that I wasn't taught the principles and techniques of direct gold. We all were taught and we all performed the necessary procedures for graduation. It just wasn't fun and we had no incentive to continue using direct gold.

Now we all know that some of our classmates never had a single problem with a gold foil restoration and enjoyed every one that was done. I envy them. I didn't start enjoying gold foil until my residency years, when requirements weren't the priority, designs of cavities were changing from what I had been taught, and I was my worst critic. However, even at that time I still had the feeling that I didn't have the right to use gold foil because I wasn't good enough. To be honest, there are times when I still feel that I am out of my class. That is the point I am trying to make when I say that we should consider "Ourselves" under disadvantages. Grainger (1971) said that our young people need models of what man at his best can be. I agree models are necessary, but I am afraid that what we have had, instead, are idols. Idols are a disadvantage, because the student never feels as if he or she can reach that level and consequently the result is frustration and aversion.

Miller (1974) said that the problem today is lazy and apathetic faculty that aren't competent in gold foil. This is true, but where did this faculty get that attitude? Was it from "Ourselves"? Did we perform for these people when they were in school, instead of teach? Did we tell them how difficult it was to accomplish this finest of restorations? Did we unwittingly discourage them from pursuing excellence in operative dentistry? Wolcott (1974) said that the school and teachers are responsible for these catastrophic deficiencies in our newly graduated professionals, because they certainly would not choose deliberately to abandon their integrity and self-destruct by poor performance. No, instead they choose not to place gold foil restorations, and become critics as a defense for not using gold foil.

By now, some of you are wondering how I can make these accusations. Well, I would like to give one more example of "Ourselves" as a disadvantage. We all remember when powdered gold came into this country and Drs Baum and Lund worked so hard to get it accepted as a direct gold restorative material. Powdered gold was easier to handle than gold foil, was inherently cohesive, could be condensed by hand pressure, had greater density than gold foil, and gave restorations that were harder than gold foil (Lund & Baum, 1963). Richter and Cantwell (1965) said that powdered gold had kindled renewed interest in cohesive gold restorations and they caused less trauma while being placed in less time. Here we had an opportunity to further the direct gold restoration through the use of powdered gold. What did we do? Many of us fought this advancement and even came out vocally against its use. Even today we still have schools that do not teach the use of powdered gold or the Loma Linda designs of cavities. Of course we have many schools that do not teach any gold foil, so maybe I shouldn't be too critical. But I am afraid that if we continue to resist good changes then direct gold as a restorative material will become outdated.

We must take a good look at ourselves and re-evaluate our positions. Do we want to be role models or idols? Do we want the gold foil restoration replaced by the composite materials, so that mediocrity can replace excellence? Do we want this to be the future of dentistry? (Figs 5 & 6)

If we are going to make an effort to preserve

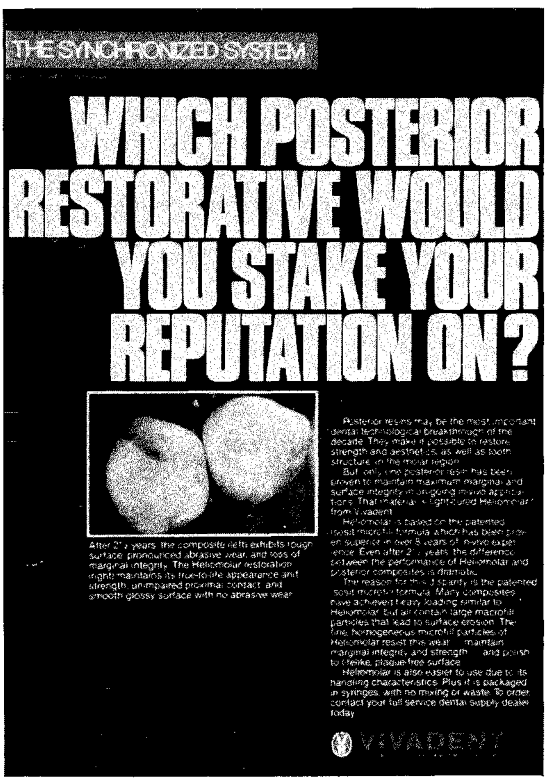

FIG 5. *Wouldn't you rather stake your reputation on direct gold?*

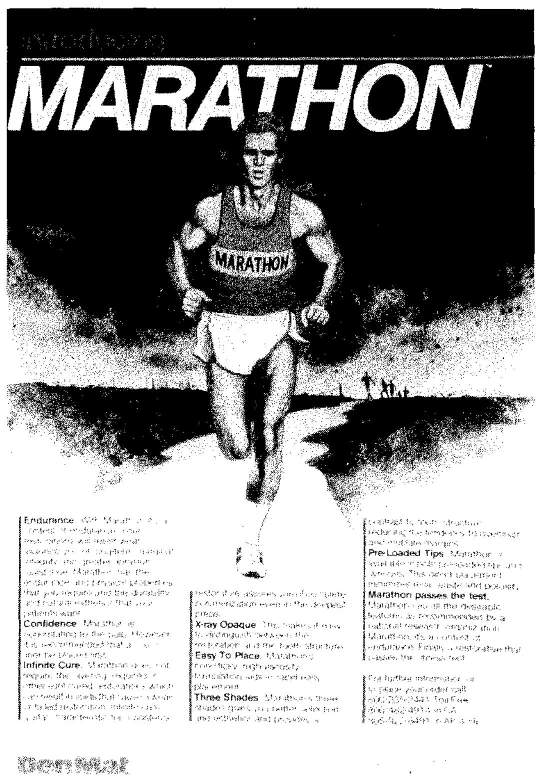

FIG 6. *No restoration is more durable than direct gold.*

and encourage the use of direct gold as a restorative procedure we need to do much more in this wonderful world of marketing. I don't know if you realize how distasteful the word 'marketing' is to me, but since we have been blessed with it by a past-president of the American Dental Association, I guess we have to live with it.

When was the last time you saw an article on direct gold restorations in a "popular" journal? By popular I mean journals such as the *Journal of the American Dental Association*, the *Journal of the Academy of General Dentistry*, and the new *Compendium of Continuing Education*. The journals to which we always submitted our articles are the *Journal of the American Academy of Gold Foil Operators*, the *Journal of Prosthetic Dentistry*, and *Operative Dentistry*. Although these journals are among the most credible, we did not get our message to the majority, only to those who already believed. Today, we need to publish more than ever before and get our message to all of our colleagues. Let's write for the *Journal of the American Dental Association*, the *Journal of the Academy of General Dentistry*, the *Compendium of Continuing Education*, and state journals, and tell everyone how easy it is to place direct gold and how rewarding it is from the standpoint of both economics and satisfaction. We need to present a positive image for all to see.

Let's take a final look at "Ourselves," and if we are a disadvantage then it's time for a change. Knowledge is the power we have to perpetuate quality in dentistry. If we do not use it soon the gold foil restoration will be no more than a chapter in dental history (Fig 7).

FIG 7. *This monument is at the US Air Force Academy in Colorado Springs, Colorado.*

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POINT OF VIEW

Contributions always welcome

Gold Foil: A Potential Practice Builder in the '80s

BRADLEY J HARKEN

Is gold foil, long considered dentistry's finest restoration, just another ego builder for elite dentists in the Pacific Northwest? Hardly, but it may be just the thing for the beginning practitioner as well as the established dentist to build a new practice or bolster an older one. "How?" you ask. Let's explore the possibility and how to put it to use.

Dentistry, as you know, has become an almost overcrowded profession. Dentists have felt the pinch with a decreasing load of patients over the last few years. Beginning dentists have had to shift their sights from opening their own practices, to the military, associateships, or buying an existing practice. To succeed in the hard-time economics of today, many suggestions have been offered; for example, have the nation's dental schools cut back enrollment as too many new dentists are graduating and overcrowding the profession, or advertise to make oneself more visible. Yet these solutions, which are beyond the bounds of professionalism and ethics, are masking the true problem. Americans want dentistry of high quality, and if you can provide it your chances for success greatly increase.

High quality is epitomized by the gold foil restoration, so "How can I put gold foil to use as a practice builder?" you ask. Let's examine the strategy.

One of the key strategies of marketing in almost any business is to offer a product or service that no one else is offering. The concept is simple—if someone desires this product or service he or she has to go to whom or to where it is being offered. A case in point—if you were to pick up the yellow pages and select 100 dentists at random, I seriously doubt whether two out of the 100 would offer the patient gold foil as a choice. So there you have point one: using gold foil to expand your repertoire of dental service capabilities.

Which brings us to point two: you must give the patient a chance to make a choice. If the patient is not educated about gold foil or is not given gold foil as an alternative treatment, of course gold foil won't be chosen in the treatment plan. Surprisingly enough, if a patient is educated as to the pros and cons of gold foil and

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its indications versus amalgam or composite, a significant percentage will choose gold foil over amalgam. Many disbelievers point to the difference in cost between gold foil and amalgam or composite as a major deterrent in the use of gold foil. Many also point to a diminishing margin of profit resulting from the extra time involved to perfect a gold foil restoration and the inability to justify to the patient the additional cost for the benefits gained.

Presentation of information so that a patient is afforded the chance to make an intelligent and informed decision is a key to success in any general practice. How can gold foil be chosen over amalgam and composite when amalgam and composite are so much less expensive? Well, it runs along the same lines as buying a Mercedes Benz. A Mercedes Benz is a very expensive automobile, yet the company sells a lot of cars. People don't mind paying more for the utmost in quality and longevity, not only in their cars but also in their dental care. Stanley Marcus, formerly chairman of Neiman-Marcus, summarizes this idea best in his book, *Quest for the Best.* He states, "As long as there are different sizes of oranges, there will be customers willing to pay more for the largest and juiciest." Thus, in promoting gold foil as an alternative within the limits of its use, education of the patient is a must.

Education of patients brings forth many points. Gold foil has the longest life expectancy of any dental material in use today, upwards of 50 years when placed correctly versus amalgam or composite with a life expectancy of 3 - 5 years, depending on whose studies you look at. Eventually amalgam or composite will have to be replaced at the expense of tooth structure because the cavity will have to be enlarged and refined to sharpen cavosurface margins, remove recurrent decay, and so forth. With that in mind, the longevity of gold foil is consistent with conservation of tooth structure and the philosophy of saving and protecting the dentition throughout the lifetime of the patient. Gold foil is also the most biocompatible restoration the dental profession can provide along with having the best marginal integrity or seal of any restoration. Gold foil when placed properly is an esthetic restoration; with conservative cavities mere hints of gold can be detected giving the slight glimmer of a healthy mouth. One final selling point, it is a one-appointment procedure versus a two-appointment procedure for an inlay or amalgam. All these points show the patient the capabilities of the gold foil restoration and make it easier for the patient to reach a decision based on knowledge rather than just his or her pocketbook.

In response to the criticism about the time it takes to produce a gold foil restoration; it does take longer to perfect a restoration of gold foil than one of amalgam or composite. This can be used to your advantage in building your practice. For the beginning practitioner, the time spent to perfect a gold foil is not wasted because the appointment book is not always filled and your time may be spent otherwise, such as waiting around for those 5 - 10 amalgams or composites that may or may not walk into your office. The beginning practitioner as well as the well-established dentist can benefit in that the time spent fosters better patient rapport and the feeling of high quality. This all translates into a better relationship between dentist and patient and more word-of-mouth referrals; for as Marcus has observed, "Sometimes recognition comes slowly, but eventually the discriminating customer discovers the best and passes the word around."

A final point I would like to emphasize is that taking the time to learn and perfect the art of gold foil pays off not only in the aforementioned strategies but affords the dentist a new look at quality. The fineness and exactness of gold foil shows up in all other facets of one's dentistry, establishing your practice as one of high quality in every aspect. It is a fine tuner of dental craftsmanship.

I offer the above suggestions as a new and exciting way to build a dental practice in the '80s.

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Distinguished Member Award

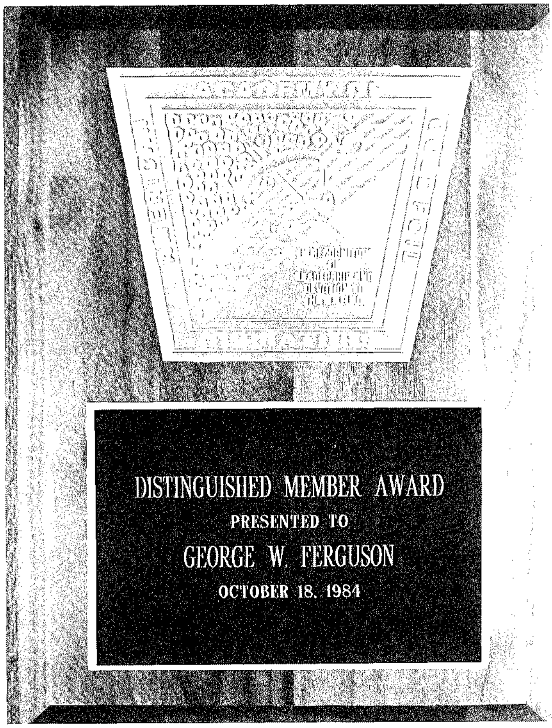
It is my distinct pleasure to be asked to present the Distinguished Member Award of the American Academy of Gold Foil Operators to Dr Bill Ferguson, recognized by all of us as the ultimate professional. We all know him and have been inspired by his idealism and solid personal and professional philosophy, but because of his humility we may not know of his many accomplishments.

As you would expect, his curriculum vitae does not fully describe his many significant achievements. Most of you know he graduated from the University of Nebraska Dental School in 1934 and practiced in Lincoln until 1942 when he answered the "call to arms" by joining the Navy where he served until 1966, advancing in rank from lieutenant junior grade to captain. During his Navy career he served in numerous stations in the United States, Germany, Korea, Japan, and Hawaii. One of his most influential assignments was to The Naval Dental School in Bethesda, Maryland. During his 12½ years of service on that faculty, he made, by his inspirational leadership, a major impact on the quality of dentistry practiced in the Navy. Those touched by him have, in turn, inspired others so that his influence has been truly amazing.

George W Ferguson

Another very significant accomplishment was that Bill was the first Navy Guest Researcher at the dental section of the Bureau of Standards. It was here that he studied and worked under Dr George Paffenbarger, who was in charge of the American Dental Association Research Unit.

Bill Ferguson retired from the Navy in 1966 after a brilliant career and was appointed chairman of Operative Dentistry at the State University of New York at Buffalo. Here again his strong influence was felt by students and



Plaque presented to Dr Ferguson

faculty alike. He continued to inspire greatness in those with whom he worked, until 1978 when he again retired. During his tenure at Buffalo he conceived Project Acorde, which succeeded in coordinating the teaching efforts of the departments of operative dentistry of the various dental schools. This has subsequently become the Conference of Operative Dentistry Educators (CODE), an active and effective organization to further the teaching of our discipline.

His honors and awards are numerous and include Omicron Kappa Upsilon, Nebraska 1934; Honorary Doctor of Science, Nebraska 1972; the Hollenback Memorial Prize, Academy of Operative Dentistry, 1980, as well as many others from the US Navy and universities.

I am sure we are all aware that Bill considers his finest achievement to be his family. He married Jane Boos of Lincoln, Nebraska, and they are both proud of Margaret (married to a dentist), Gretchen (married to a dentist), Mary (married and an attorney), and David (an attorney).

Julian J Thomas, Jr

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WIT AND WISDOM

Revised Program

CAROLYN F PALMER

Academy of Operative Dentistry

Fourteenth Annual Meeting

Monday & Tuesday, February 18 & 19, 1985

WESTIN HOTEL
North Michigan at Delaware
Chicago, Illinois 60611

WILLIAM N. GAGNON
President
Academy of Operative Dentistry 1984-1985

PRESIDENT'S MESSAGE

DR. WILLIAM GAGNON
President
Academy of Operative Dentistry
1984-1985

Welcome to the fourteenth annual meeting of the Academy of Operative Dentistry. This "special" will be a tremendous success, largely due to the brilliant and creative geniuses who will appear on our great program.

Several recently manifested ideas have skyrocketed to distinction in our profession; therefore, we have revised our program in order that these ideas can be presented immediately and incorporated in your daily practices and education as soon as possible.

Thanks to all for this promotion of excellence!

LADIES ACTIVITIES

Our day will begin with a visit to the John Hancock Life Insurance Building, one of the tallest structures in the United States. We will listen to an immaculately detailed seminar entitled, "How to Legally Murder Your Husband and Collect the Insurance."

We will conclude the day with a lecture demonstration on the best frying and baking techniques for this purpose at the Cook's Bazaar in the Water Tower.

Welcome to Chicago!

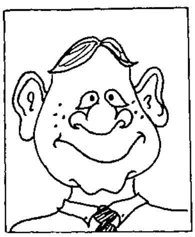
"Franchise Dentistry At Mc Donalds"

RONALD Mc DONALD
U. S. A.

Ronald Mc Donald truly believes that Mc Donalds should be a part of the healing arts. High salaried positions are now available to qualified dentists who desire to serve the public in a new and more direct manner.

Instruction concerning assembly-line operations, getting the patient in and out between the Egg Mc Muffins and the french fries will be discussed.

You deserve a break today - at Mc Donalds!



"Management of Reduced Prevalence of Dental Caries By Means of A Restorative Dentistry Deficiency"

DR. B. WACKO REEDMAN
EAST APPLE, NEW JERSEY

The recent discovery of a decreased incidence of dental caries in this country has provided an excellent opportunity for the dental profession to increase its restorative dental deficiencies. This reduction in carious lesions can and will result in astonishing decreases in hours allotted to restorative dentistry education, and astonishing increases in pulpal inflammation, exposure, and total necrosis.

Evaluation of superior techniques and materials used for the management of healthy and functional restorative dentistry deficiencies will be discussed.

TABLE CLINICS
Wellington Ballroom

1.

"Excellence in Education Via Behavior Modification"

R. Mitchell, Ph.D.
Boston, Massachusetts

2.

"Elimination of Incisal Retention in Class III Direct Gold Cavity Preparations"

John L. Abscess, DDS
New York, New York

3.

"Options for Part Time Employment in Real Estate for Dentists"

Committee for Dental Capitation
United States Government
Washington, D.C.

4.

"Double Your Credit - Double Your Fun"

R. Daly Spendit, Ph.D.
Charge-A-Card Economist
Chicago, Illinois

5.

"Ethylene Glycol as a Solvent in Detecting Carious Lesions"

Jim Brown
University of Guyana
Guyana, South America

6.

"Corporate and Executive Initials on Gold Foil Condenser Point Faces"

A. Ian Ramilton, DMD
Hollywood, California

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18 ROCKS AND A NEW CHAMPION

The account I am about to spin for you will rank high on the record of fishing yarns destined to be respun many times in years to come.

Put yourself approximately 700 air miles north of Minneapolis, Minnesota, at Deer Lake, Ontario, in the magic Canadian land of many fishing lakes, where various members of the American Academy of Gold Foil Operators have taken themselves over the years to exchange good fellowship and enjoy good fishing. Canada is entered at Fort Francis, the hub of central Canadian fishing, by crossing a 30-year-old bridge about 150 yards long from International Falls, which is about 350 miles north of Minneapolis. From Fort Francis some of this year's group drove and some went by air to Rendezvous Point at Red Lake, about 240 miles north of Fort Francis, then on by float plane the 120 miles further north to Deer Lake, where the group occupied two small cabins.

This year's group were all card-carrying members of the American Academy of Gold Foil Operators: Minnesotans Perry Dungey of Waconia, Don Benson of Rochester, and Jim Guptil of Rush City; Paul Dawson of Kansas City, Illinois; Oregonians Chet Gibson of McMinnville and H M Kemple of Bend; accompanied by Jim's brother Wally and Don's cousin.

Campfire discussion ranged around politics, religion, gourmet food, the current status of our profession, and vociferous accounts of past years' fishing stories when other members have attended, such as Tony Romano, Ralph Werner, Jack Seymour, and Dave Gadoala. The previous year's outing (1983) to Deer Lake had produced a record catch for that group—an 18-pound northern pike landed by our illustrious storyteller, Chet Gibson, who, as many of you know, does not relish coming in second; to put it nicely, he is one fine competitor in any race from foil to fish. We left the dock each morning well fortified by Jim's good breakfasts, and with a secret inner desire to bring in a fish to top Chester's '83 record.

From left to right: H M Kemple, Perry Dungey, Jim Guptil, Paul Dawson, Chet Gibson, and Don Benson.

The first fishing days produced no records at all—a variety of good to slow, rain to sun—just basically wonderful; but on the next to the last eve of fishing everyone got down to serious work. All boats cruised into camp about the same time—late. The fishermen then cruised unobtrusively around, reluctant to bare their stringers, trying not to check anyone else's catch, waiting for the first breakthrough. Finally, Jim's brother Wally couldn't stand the suspense any longer and started lifting up strings from each of the boats. When he got to Paul Dawson's boat everyone was watching. As Wally brought the stringer out of the water he was obviously putting out an extra effort. As the head, body, and tail of a very large northern pike emerged, an extra audible "Wow!" chorused through the air.

Dr Paul, spry and young at age 84, sat by the fire looking pleased beyond imagination, watching and waiting for someone to discover his catch. The pike was quickly weighed. Twenty pounds on the hand scale! A low "Whew!" circled the group.

The next 30 minutes were occupied with a replay by modest Paul and his not-so-modest boat partner, Wally. Paul's quiet description, accented with southern Illinois billygoat land jargon, went more or less like this:

"Well, about four o'clock this afternoon we were just trolling around that far point out there," and he lifted his hand to the West. "I was dragging this ol' daredevil on a 10-pound line that must be 10 years old when suddenly I hung up on something. I told Wally to back up and get me off the rocks, I was stuck. A few seconds in reverse and I picked up my line. Then the whole bottom of the lake started to move! I said, 'Wally —it's not the bottom! I've got a big one!' It took nearly 20 minutes to land the darn thing, with Wally doing most of the work. When the ol' boy came up alongside the boat, Wally swept it up with one pass of the net, but as he brought it over the side, darned if the bottom of the net didn't come apart! That big ol' fish thrashed and shook, balanced on the side of the boat, and then, by some stroke of luck, fell inside! When I sat down and looked at the size of it and knew it was lying there safe on the bottom of the boat, I just sat there and shook!"

As the replay of this 30-minute narrative started for the third time, the rest of the stringers came out and Jim, Perry, and Don began cleaning and filleting, saving the new trophy 'til last. It was decided to bring the big one home in one piece, with head and tail left on.

As the innards were being removed, I said, "Let's take a look and see what the old boy's been eating."

Jim agreed, circled his left hand gently around the stomach and laid his knife on the ventral side. "Hmmm," he said, "whatever this damn fish has been eating, it sure is hard and lumpy." As his knife made the final cut of the 'exploratory laparotomy' out rolled a total of 18 thumb-sized shore rocks, weighing in at a good two pounds.

As the rocks rolled out, so did the laughter, which lasted some five minutes. Paul's delighted smile suggested he was more pleased with his prank than with his catch. And he had a couple more authentic details to add.

"Well, fellas, you don't know what a job it was getting those rocks stuffed down the gullet of that big fella! I'll tell you, we had a time getting that big northern pike to swallow those 18 rocks! We finally had to stuff 'em down with an empty Labatt's bottle."

Well, with only a small hand scale to rely on, we could never decide who was the real champion, Chester or Paul. It is just as well that we don't have to decide between these two fine gentlemen anyway. Another fishing trip perhaps will tell.

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DEPARTMENTS

Book Reviews

GUIDE TO ANTIBIOTIC USE IN DENTAL PRACTICE

Michael G Newman and
Anthony D Goodman, editors,
with 11 contributing authors

Published by Quintessence Publishing Co, Inc, Chicago, 1984. 196 pages; indexed. $21.50

In the foreword, Dr Sidney Finegold states that a monograph on the use of antimicrobial agents in dentistry is long overdue. This is (or has been) true, and editors Newman and Goodman have filled this void in an exemplary fashion. It has been said, with all too much accuracy, that once dentists are beyond their two-drug prescription repertoire of penicillin and codeine, they are lost. This book goes a long way toward correcting that deficiency, at least in the area of antibiotics and other antimicrobial agents.

The book is divided into four parts, with a total of 16 chapters. The first portion encompasses "General Principles" and constitutes about half of the material in the whole book. "Adverse Reactions" are covered in the second portion and includes material on allergic reactions, secondary effects of antibiotics, and adverse microbial reactions. The third part, "Clinical Considerations," is divided into chapters which explore the use of antibiotics in the various disciplines of dentistry. The final section of the main text covers "Special Considerations" such as the prophylactic use of antibiotics, care of cancer patients, and legal responsibilities. Fifteen appendices follow the book's principal text, generally including numerical data or lists in the form of brief charts. A six-page index, organized by main subject and subtopics, concludes the paperbound publication.

The initial chapter, which serves as an overview of orofacial infections, provides a good, albeit brief, outline of the general principles of managing infection. This section is particularly valuable for its up-to-date delineation of bacterial organisms involved in orofacial infections. The author, James Crawford, makes it very clear that no longer can we presume that our old friends *Staphylococcus aureus* and *Streptococcus pyogenes* are the primary pathogens in odontogenic infections. The well-designed charts in this chapter indicate the most likely pathogens in various types of infections, including abscesses in children, infections of the perimandibular space, and necrotic root canals. The most contemporary information derived from the literature regarding the predominant organisms in acute infections is also specified for each type of lesion. A nice summary of the indications for the use of antibiotics is listed, along with some guidelines for drug dosage and duration of therapy. It is particularly gratifying that the author emphasizes that removal of the source of infection and establishment of drainage are essential.

Guidelines for choosing antibiotics are established in the second chapter, authored by the two coeditors, Newman and Goodman. In addition to describing the advantages of the various agents, the authors present an excellent graphical representation of the attainment of effective blood levels for each of the antibiotics and routes of administration. At the end of the chapter a simple step-by-step summary is listed along with a table of appropriate dosages.

The use of topical antibacterial agents, including chlorhexidine and fluoride, is discussed in chapter 3. This chapter's main thrust is directed toward the management of caries and periodontal disease, and little attention is paid to other topical therapy. Chapter 4 is a relatively brief, but detailed, depiction of antibiotic sensitivity testing, which leads directly into the next chapter covering the taking and delivery of culture samples. These are both probably new topics for many dentists, and are dealt with adequately for both neophyte and experienced clinician.

Leading off the section on adverse reactions is a chapter covering allergic and sensitivity reactions. This deals with the subject nicely, discussing the general principles of allergy and then the specifics of penicillin and other antibiotic allergy. The author also outlines the management of allergic emergencies. Chapter 7 is a brief (two-page) discussion of colitis and diarrhea that might have been included in a general treatise on adverse effects of antimicrobial agents in combination with chapter 8, which covers adverse microbiologic effects.

The third section is devoted to the use of antibiotics in the specialties of dentistry, and in the ninth chapter author Sebastian Ciancio discusses the applications of antimicrobial therapy in periodontics. Included is information on the use of tetracyclines in periodontal therapy. Chapters 10 and 11 cover the use of antibiotics in endodontics and oral and maxillofacial surgery, respectively. Those prescribing antibiotics for children will be interested in chapter 12, with its discussion of the special considerations of the child patient.

The final section does, as described, have special considerations. In addition to recommendations for antibiotic prophylaxis (chapter 13), some out-of-the-ordinary topics are included in systemic considerations for women and the treatment of cancer patients. Since the management of infections by dentists not uncommonly (regrettably) ends in some legal entanglements, it is appropriate that the last chapter deals with some of the ensuing (no pun intended) legal considerations.

In many ways the appendices (15 of them), by themselves, are worth the price of the book. They cover, in charts or lists, the pertinent information, however distilled, from the preceding main text. They serve as an excellent review and reference source after digesting the preceding 170 pages.

As stated earlier, this book is a unique undertaking, one which is unfortunately long overdue. With only minor missteps it provides a succinct but comprehensive treatise on the use of antibiotics in dental practice. The format is well suited to the topic and the manner in which the material is presented is both pleasing to the mind and the eye. As a general practitioner, I would recommend the book to specialist and generalist alike. It is particularly well suited to dentists in training, either predoctoral students or those in postdoctoral programs. Both the framework and the content provide a balance between the practical and the esoteric aspects of the use of antibiotics. All in all, this is a product of which the authors and editors can be proud.

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PRECISION ATTACHMENTS IN PROSTHODONTICS: The Applications of Intra Coronal and Extra Coronal Attachments

By Harold E Preiskel, MDS, MSc, FDSRCS

Published by Quintessence Publishing Co, Inc, Chicago, 1984. 318 pages, color illustrations, indexed. $68.00

With today's emphasis on prevention, retention of the natural dentition, and esthetics, there is more interest than ever before in the subject of precision attachments in removable partial prosthodontics. This topic is minimally addressed in most undergraduate curricula and, as a consequence, most practitioners have inadequate training to properly fabricate such prostheses. This text, in the words of the author, "is directed to the experienced practitioner, specialist and postgraduate student, although I hope it will be of interest to the advanced undergraduate as well." When coupled with sound knowledge of the function of conventional removable partial prosthodontics, a thorough understanding of the material presented in the text should give the practitioner a sound foundation for providing such a sophisticated service.

The present text is essentially a revision of a major portion of a previous text entitled *Precision Attachments in Dentistry,* third edition, published by C V Mosby Co in 1979. The first seven chapters of both texts bear identical titles, with the present text adding an eighth chapter entitled, "Problems with Attachment Retained Prosthesis," and omitting the chapters on overdentures and related attachments that were included in the earlier text. These topics are to be addressed in a subsequent volume.

This new text is a substantial improvement upon the previous volume, in terms of revisions, added material, and the quality of the illustrations. The color photographs used are excellent reproductions and superior to the black and white photographs in the preceding text. The color illustrations enhance the text and clearly demonstrate the principles described.

The first chapter appropriately discusses diagnosis and treatment planning, and includes an excellent discussion on indications and contraindications for various prostheses. The second chapter, contributed by John S Zamet, covers various forms of preparatory periodontal therapy required for this type of rehabilitation. While this chapter is well written and illustrated, the need for a chapter of this depth, especially describing the actual techniques of periodontal therapy, must be questioned.

The third chapter on occlusion is well done and outlines the concepts of vertical dimension and various occlusal schemes that are used in such prosthodontic care. The fourth chapter, describing the problems related to the distal extension prosthesis, is the most important chapter in the book. The discussion presented here is invaluable to the understanding of the function of both conventional and precision-attachment removable partial dentures. Such an understanding is essential if functional, physiologic prostheses are to be fabricated.

The next three chapters cover various types of attachments, including prefabricated, intracoronal, and extracoronal attachments. Advantages and disadvantages of the various systems are given, and step-by-step techniques for clinical use of several specific attachments are presented. The observant reader is soon impressed with the high degree of finesse required to provide such a restorative service. The proper selection and manipulation of various dental materials and meticulous execution of specific clinical techniques is continually emphasized. The final chapter includes a discussion on some of the many problems associated with precision attachments.

Overall, the book is well written, logically constructed, and beautifully illustrated. It provides the reader with an excellent working knowledge of many of the various attachments available and a general idea of how and where to use them. Although details of technique are frequently covered in the text, careful review of the manufacturer's literature on proper handling of the various prefabricated attachments is imperative. The section on the Thompson dowel, contributed by Dr Alex Koper, is a valuable addition and the reader would do well to review this semiprecision intracoronal attachment, which has served admirably for over four decades.

The primary justification for partial dentures with precision attachments in preference to conventional removable partial dentures is esthetics. Use of such precision attachments necessarily makes treatment more complex and increases the cost of service. With proper understanding of the function of removable partial dentures, design of attachments, and meticulous execution of clinical technique, highly esthetic, functional, and physiologic restorations can be fabricated. This text provides the practitioner with much of the basic information required towards achieving that goal.

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Letters

Longevity of Amalgam Restorations

In response to your editorial in the Summer 1984 issue of *Operative Dentistry,* I feel that amalgam material still has an important place in dentistry, both as a device for learning skills and as a permanent restorative material. It has proven itself cost effective for over 150 years and is a material that is available to the masses. I sometimes suspect my colleagues in ivory towers do not see the real dentistry of the day and these same colleagues are not aware of the real needs of patients in relationship to their perceived life styles and priorities.

I am prepared to go out on a limb and suggest these new high copper alloys will last a lifetime in many of the patients treated in the '80s. I would also suggest the love affair dentists have with gold is in part related to the delight one has in handling it and not in its supposed longevity.

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Announcements

NEWS OF THE ACADEMIES

American Academy of Gold Foil Operators

The 34th annual meeting was held 18-19 October 1984 at Emory University School of Dentistry and the Lanier Plaza Hotel, Atlanta, Georgia. Clinical operations of direct gold restorations were demonstrated during the morning of 18 October. During the afternoon the members and their guests were given a tour of the city of Atlanta. The day concluded with a reception and banquet in the Ballroom of the Lanier Plaza Hotel. The banquet was complemented with a delightful address on "This Old Gang of Mine" by Corky Carnahan and the evening was concluded with the presentation of the Distinguished Member Award for 1984 to George W Ferguson. The next morning was given to reports and essays, the theme of which was "Why Bother Continuing to Use an Outdated Restorative Like Direct Gold?"

The officers of the academy for the forthcoming year are: president, Ronald K Harris; president-elect, Nelson W Rupp; immediate past-president, William J Roberts; vice-president, Julian J Thomas, Jr; secretary-treasurer, Ralph A Boelsche; and councillors, Allan G Osborn, Richard V Tucker, William H Harris.

NOTICE OF MEETINGS

Academy of Operative Dentistry

Annual Meeting: 18 and 19 February 1985
Westin Hotel
Chicago, Illinois

American Academy of Gold Foil Operators

Annual Meeting: 31 October and
1 November 1985
University of California
San Francisco, California

Press Digest

The effect of cytotoxic therapy on saliva and oral flora. Main, B E, Calman, K C, Ferguson, M M, Kaye, S B, MacFarlane, T W, Mairs, R J, Samaranayake, L P, Willox, J and Welsh, J (1984) *Oral Surgery, Oral Medicine, and Oral Pathology* 58 545–548.

Patients on cytotoxic chemotherapy for malignancy have a reduced flow of saliva, a decrease in salivary amylase and IgA, and an increase in the levels of *Candida,* coliforms, and *Staphylococcus aureus* in saliva.

Endosonic endodontics: the ultrasonic synergistic system. Martin, H and Cunningham, W (1984) *International Dental Journal* 34 198-203.

An instrument activated by ultrasound that has been designed to clean, irrigate, disinfect, and shape root canals has received favorable comments on its performance. The instrument consists of a handpiece that accepts both steel and diamond files, a reservoir for a bactericidal irrigant, and a source of ultrasonic energy (Cavitron). The irrigant passes through the handpiece thus permitting simultaneous irrigation, cleansing, and disinfection of the root canal. Diamond files cut more effectively than steel files and leave a smoother surface on the dentin, the flow of irrigant preventing clogging of the diamonds. The combination of ultrasonic energy, continuous irrigation, and diamond files allows the dentist to prepare root canals easily and effectively.

The retention of fissure sealants using twenty-second etching time. Eidelman, E, Shapira, J and Houpt, M (1984) *Journal of Dentistry for Children* 51 422-424.

Shortening the time of etching from 60 seconds to 20 seconds resulted, at the end of a year, in 99% retention of a sealant (Delton) in the occlusal fissures of 89 first permanent molars of children aged 5.5 - 6.5 years.

The antimicrobial activity of modern mouthwashes. Grenby, T H and Saldanha, M G (1984) *British Dental Journal* 157 239-242.

Tests for antimicrobial activity of nine mouthwashes showed Corsodyl (ICI), containing chlorhexidine gluconate, to be the most effective, followed by Listermint (Warner-Lambert) and Merocet (Merrell) both containing cetylpyridinium chloride and Oraldene (Warner-Lambert), containing hexetidine, these last three mouthwashes being about equal in antimicrobial activity. A long way behind these first four were Vademecum (Barnangen, Sweden), containing menthol and unspecified antiseptics, Dettol mouthwash (Reckitt & Coleman), containing chloroxylenol, Listerine (Warner-Lambert), containing benzoic acid, eucalyptol, menthol, thymol and methyl salicylate, and Mintgard (Unicliffe Ltd), containing benzoic acid. Odol (Beecham Proprietaries), active ingredients unspecified, had very little antimicrobial activity. The mouthwashes containing cationic surfactants, such as cetylpyridinium chloride, and complex organic nitrogenous compounds, such as hexetidine, were more active than the mouthwashes containing older formulations based on phenol.

INSTRUCTIONS TO CONTRIBUTORS

Correspondence

Send manuscripts and correspondence about manuscripts to the Editor, Professor A Ian Hamilton, at the editorial office: OPERATIVE DENTISTRY, University of Washington, School of Dentistry SM-57, Seattle, WA 98195, USA.

Exclusive Publication

It is assumed that all material submitted for publication is submitted exclusively to *Operative Dentistry*.

Manuscripts

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.

Tables

Submit two copies of tables typed on sheets separate from the text. Number the tables with arabic numerals.

Illustrations

Submit two copies of each illustration. Line drawings should be in india ink or its equivalent on heavy white paper, card, or tracing vellum; any labeling should be on an extra copy or on an overleaf of tracing paper securely attached to the illustration, not on the illustration itself. Type legends on separate sheets. Photographs should be on glossy paper and should be cropped to remove redundant areas. For best reproduction a print should be one-third larger than its reproduced size. Maximum size of figure is 15x20 cm (6 x 8 inches). The cost of color plates must be met in full by the author. On the back of each illustration, near the edge, indicate lightly in pencil the top, the author's name, and the number of the figure. Type legends on a separate sheet. Where relevant, state staining techniques and the magnification of prints. Obtain written consent from holders of copyright to republish any illustrations published elsewhere.

References

Arrange references in alphabetical order of the authors' names at the end of the article, the date being placed in parentheses immediately after the author's name. Do not abbreviate titles of journals; write them out in full. Give full subject titles and first and last pages. In the text cite references by giving the author, and, in parentheses, the date, thus: Smith (1975) found . . .; or, by placing both name and date in parentheses, thus: It was found . . . (Smith & Brown, 1975; Jones, 1974). When an article cited has three authors, include the names of all of the authors the first time the article is cited; subsequently use the form (Brown & others, 1975). Four or more authors should always be cited thus: (Jones & others, 1975). If reference is made to more than one article by the same author and published in the same year, the articles should be identified by a letter (a, b) following the date, both in the text and in the list of references. Titles of books should be followed by the name of the place of publication and the name of the publisher.

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