OPERATIVE DENTISTRY

winter 1980 • volume 5 • number 1 • 1–40

(ISSN 0361-7734)

OPERATIVE DENTISTRY

WINTER 1980 • VOLUME 5 • NUMBER 1 • 1–40

Aim and Scope

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

Publisher

Operative Dentistry is published four times a year: Winter, Spring, Summer, and Autumn, by the American Academy of Gold Foil Operators and the Academy of Operative Dentistry.

Subscriptions

Yearly subscription in USA and Canada, $20.00; other countries, $24.00 ($27.00 air mail); dental students, $13.00 in USA and Canada; other countries, $17.00; single copy in USA and Canada, $7.00; other countries, $8.00. Make remittances payable (in US dollars only) to *Operative Dentistry.*

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EDITORIAL

Treating the Whole Complex

The formation of complex structures from simple components is a fascinating subject to study. So much can be created when the elements are combined in the proper relationship. The parts of a car when piled on the floor are not of themselves of much use, but assemble them correctly and a most useful product is formed. Usually the complex structure possesses properties that could not have been predicted from the attributes of the individual parts. Sodium, for example, is a silvery-white metal and chlorine a yellowish-green poisonous gas, yet combine them and they form white table salt, which is relatively innocuous and, as normal saline, greatly beneficial. The creation of life from inanimate elements also exemplifies the unexpected results of complexity.

As simple elements combine to form more complex aggregates and these in turn combine to form structures of increasing complexity, different levels of organization arise. In human beings, for example, cells combine to form tissues, tissues to form organs, organs to form systems, and systems to form the human organism. Nor is that the end of it. At the lower level cells are composed of organelles and these in turn are composed of simpler elements, whereas at the upper level human beings combine to form families, societies, and so on.

To understand how a complex system functions it helps if the various levels of organization can be distinguished because each presents different problems of analysis requiring different concepts and methods of investigation. A light microscope may suffice for observing tissues but the detail of cells requires an electron microscope.

One may enter the study of complexity at any particular level and move up and down the hierarchy of levels as circumstances demand. The explanation of the mechanisms by which any particular level works is found in the level below, and the purpose or significance in the level above. For example, oral epithelium is a tissue that continually renews itself, a feature discovered by a study of the component cells; at the same time oral epithelium as a constituent of an organ, mucous membrane, serves to protect the underlying tissue.

Teeth are organs comprising the tissues, enamel, dentin, cementum, and pulp. Teeth are also elements of the masticatory system, which in turn is a subsystem of the human organism.

There now seems to be confusion about the relation of the teeth to the human organism. Comprehensive treatment is a fashionable term implying that treatment of diseases of the masticatory system usually requires a combination of several types of treatment in a proper sequence if a patient is to receive adequate service. This concept is commendable and necessary for good treatment, but there has been a tendency to focus on the levels of the masticatory system and the patient at the expense of the teeth. There has been a propensity also to censure those that operate on teeth as having an unduly narrow perspective, even though the treatment of dental caries is by far the largest part of the practice of dentistry and even though operative dentistry is the basis for most of the other branches of clinical dentistry. As a consequence the relative importance of operative dentistry has been depreciated. We are trying to treat dental disease without treating teeth, or with treatment that is neither adequate nor durable. That is like trying to maintain a car without servicing the main components, such as the motor, or by making repairs with defective parts—it won't work.

The concept of comprehensive treatment and its importance to the patient are easy to apprehend and should tax the intelligence of no one; the skill to provide the treatment is much more difficult to acquire. There is nothing inconsistent about treating teeth individually and integrating the treatment to serve the masticatory system and the patient. All three levels are important but the proper perspective needs to be restored.

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OPERATIVE DENTISTRY, 1980, 5, 2–6.

ORIGINAL ARTICLES

Favorable Locations for Pins in Molars

Knowledge of the thickness of dentin and the anatomy of the tooth in the cervical region shows that the line angles, or corners, of molars are the best sites for retentive pins.

JAMES V GOURLEY

Introduction

The efficient use of pins in teeth requires a knowledge of the anatomy of the cervical third of both the crown and root and a knowledge of the thickness of dentin at various levels within the tooth. As only limited information is available on the measurements of tooth anatomy (Black, 1902; Wedelstaedt, 1897; Arnim, 1959; Dilts & Mullaney, 1968) this study was designed to measure the thickness of dentin at several levels within adult molar teeth. The thickness of the dentin was then related to the external anatomy of the teeth to predict the most favorable locations for placing holes for retentive pins.

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Materials and Methods

One hundred first or second molars (50 maxillary and 50 mandibular) were selected. All the teeth were free of caries and restorations, except a few that contained sound, small restorations in occlusal or facial pits.

Casts of the teeth were made before they were processed. Radiographs were taken in both faciolingual and mesiodistal views. Mercaptan rubber impressions were made of the entire crown and half the root of each tooth and the impressions poured in die stone. The teeth were then embedded in resin (Ward's Bio-Plastic, Ward's Natural Science Establishment, Inc., Rochester, NY 14603, USA). The blocks of set resin were trimmed to orient the long axis of the tooth parallel to the surface of the block. This positioning of the specimen within the resin block ensured that the sections would be at right angles to the long axis of the tooth (Fig 1). Two parallel grooves and a diagonal groove were cut in adjacent sides of the long axis of the block for proper orientation (Gillings & Buonocore, 1961). The teeth were sectioned throughout their length at a cutting interval of one millimeter (Fig 2) with a Gillings-Hamco Thin Sectioning Machine. The sections were removed from the mounting plate, mounted on

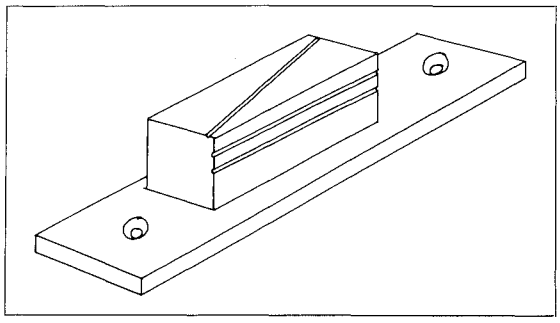

FIG 1. *Diagram of an embedded tooth block cemented on a mounting plate in preparation for sectioning. Two parallel grooves and a diagonal groove cut in adjacent sides of the block provide orientation of the sections.*

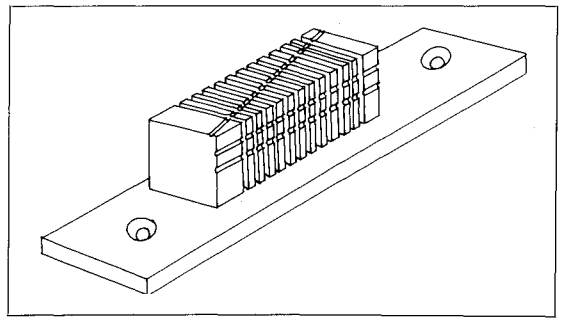

FIG 2. *Diagram of an embedded tooth after sectioning. The grooves provide orientation for reassembly of the sections in proper order after removal from the mounting plate.*

lantern slides with the coronal surface exposed, and then measured.

Six sections of each tooth were chosen for measuring the thickness of dentin. One section was located at the cervical line, two were occlusal to the cervical line and three apical to the cervical line (Figs 3a & b). The location of the sections for measurement was selected on the basis of clinical experience with placing pins. The average thickness of dentin was computed at eight positions around the periphery of the crown, namely, at each line angle and the middle of each surface. Desirable locations for placing pins were determined by comparing the average thickness of dentin at each position in an occlusal to apical direction.

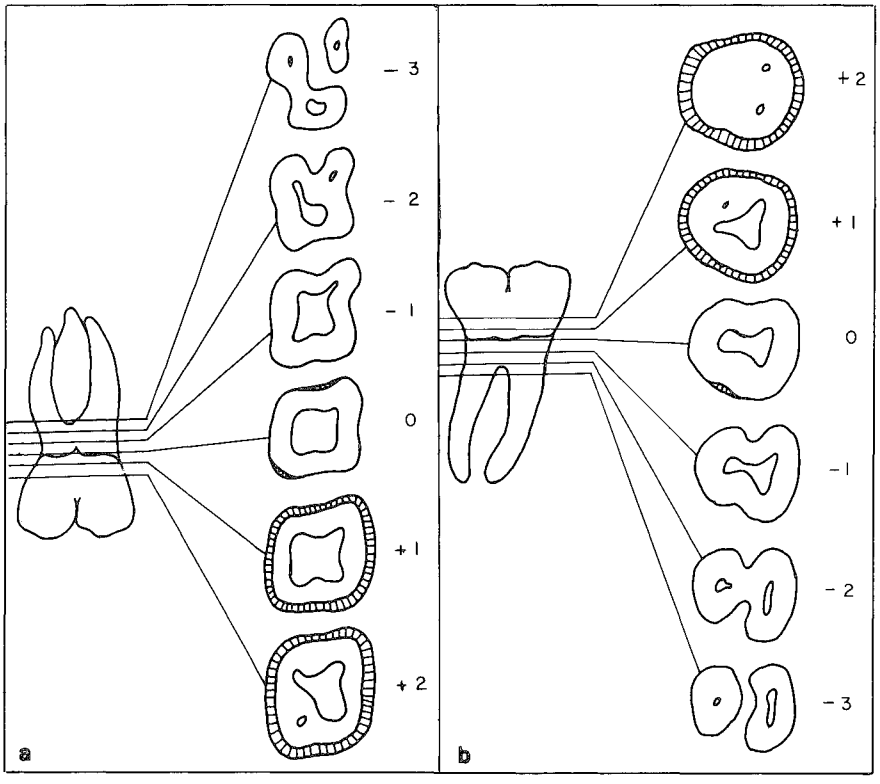

FIG 3. *The six levels measured on the (a) maxillary molars, and (b) mandibular molars. The numbers indicate distance in millimeters occlusal (+) and apical (–) from the cervical line (0). Cross sections were traced from photographs of representative mandibular and maxillary specimens. All sections are oriented with the facial surface toward the bottom of the page.*

Results

The average thickness of dentin at each position is given in Tables 1 and 2. The average thickness at the line angles, or corners, was consistently higher at each level than the thickness in the middle of the tooth surfaces. A rapid decrease in thickness of dentin in an occlusal to apical direction indicates a poor position for pinholes, whereas a constant average thickness of dentin in an occlusal to apical direction indicates a favorable position.

Examination of the sections and the radiographs of each tooth disclosed that teeth with large pulp cavities have relatively thin walls of dentin and teeth with small pulp cavities have relatively thick walls.

Discussion

The minimum thickness of dentin is of great importance. Low values in a given location for a large proportion of the specimens indicate a poor site for placing pinholes because of the thin dentin and the relatively high probability of penetrating the pulp or the periodontal ligament.

The recommended minimum thickness of dentin in which to place a pinhole is three times the diameter of the pinhole. Thus a pinhole with a diameter of 0.5 mm requires at least 1.5 mm of dentin, allowing 0.5 mm of dentin between the hole and the pulp and between the hole and the surface of the tooth. Converting the diameters of pinholes from thousandths of an inch to tenths of a millimeter provides a measurement that is more easily interpreted (Table 3). The use of thousandths of an inch makes the size of the pinhole sound very small, but the use of millimeters enables the clinician to compare the size with conventional measurements used in cavity preparation.

The favorable locations in which to place pinholes in molars are the line angles, or corners. To establish the proper direction of the pinhole, the drill is placed in the sulcus parallel to the root surface and moved to the desired location without changing the angulation as the hole is drilled (Markley, 1967), or a small instrument may be placed in the sulcus parallel to the root surface as a guide in establishing the desired angulation for the drill.

Table 1. Average Thickness of Dentin (mm) of Maxillary Molars

Level of Measurement*	Positions Measured**							
mm	F	MF	M	ML	L	DL	D	DF
+2	2.3	2.2	2.0	2.6	2.5	2.3	2.3	2.2
+1	2.3	2.3	2.1	2.5	2.4	2.4	2.3	2.3
0	2.3	2.3	2.2	2.5	2.4	2.5	2.3	2.4
−1	2.1	2.2	2.1	2.4	2.2	2.3	2.2	2.4
−2	1.5	2.1	1.7	2.2	2.1	2.3	1.8	2.3
−3	0.8	1.9	1.0	2.2	1.9	2.1	1.1	2.0

* (+) Crown, (0) Cementoenamel junction, (−) Root

** F, middle of the facial surface; MF, mesiofacial angle; M, middle of the mesial surface; ML, mesiolingual angle; L, middle of the lingual surface; DL, distolingual angle; D, middle of the distal surface; DF, distofacial angle.

Table 2. Average Thickness of Dentin (mm) of Mandibular Molars

Level of Measurement*	Positions Measured**							
mm	F	MF	M	ML	L	DL	D	DF
+2	2.5	2.5	2.1	2.2	2.1	2.1	2.4	2.3
+1	2.6	2.7	2.3	2.1	2.1	2.3	2.4	2.5
0	2.6	2.7	2.3	2.4	2.4	2.4	2.4	2.6
−1	2.5	2.6	2.3	2.6	2.3	2.6	2.3	2.6
−2	1.9	2.4	2.0	2.5	1.8	2.5	2.0	2.5
−3	0.8	2.2	1.5	2.2	0.7	2.3	1.8	2.4

* (+) Crown, (0) Cementoenamel junction, (−) Root

** F, middle of the facial surface; MF, mesiofacial angle; M, middle of the mesial surface; ML, mesiolingual angle; L, middle of the lingual surface; DL, distolingual angle; D, middle of the distal surface; DF, distofacial angle.

Table 3. Pinhole Sizes Converted from Inches to Millimeters

Type of Pin	Diameter in	Diameter mm
Cemented	.021	0.53
	.027	0.69
Self-threading	.013	0.28
	.017	0.43
	.021	0.53
	.027	0.69
Friction grip	.021	0.53

Two locations where there is an adequate amount of dentin, but where this method of determining angulation of the hole is contraindicated, are the lingual of the maxillary molars and the distal of the mandibular molars. The difficulty in obtaining proper direction of the pinhole in these locations is due to the abrupt angulation of the roots just apical to the cementoenamel junction. Placing a pinhole parallel to the outline of the crown in these areas tends to direct the pinhole into the pulp.

The middle of tooth surfaces is not a good location for pins, primarily because of external anatomy. Placing pins in these areas can easily involve the furcations of the roots of the maxillary molars or the flutings on the mesial roots of the mandibular molars. The high incidence of furcations extending to within three millimeters of the cementoenamel junction greatly increases the danger of perforating the surface of the tooth if pins are placed in the middle of the facial, mesial, and distal surfaces of maxillary molars. The location of the bifurcation of the roots of mandibular molars also discourages the placing of pins in the middle of the facial and lingual surfaces of these teeth.

Radiographs are useful when considering the use of pins for gaining additional retention for restorations. The radiographs reveal abnormalities in size or position of the pulp cavity.

The anatomic features revealed by the casts and sections support the findings of Sasaki (1968) that large teeth have more pronounced features, such as the presence of furcations nearer the cementoenamel junction and deeper flutings on the roots.

Pins must be placed in areas where there is adequate dentin to permit each pin to provide maximum retention, and the number of pins must be kept to a minimum to prevent reducing the strength of amalgam (Going, 1966; Wing, 1965). Pinholes must be entirely surrounded by dentin to prevent fracture of the enamel when the pin is seated (Figs 4a & b). The danger of penetrating either the pulp or the periodontal ligament increases with the depth of the pinhole.

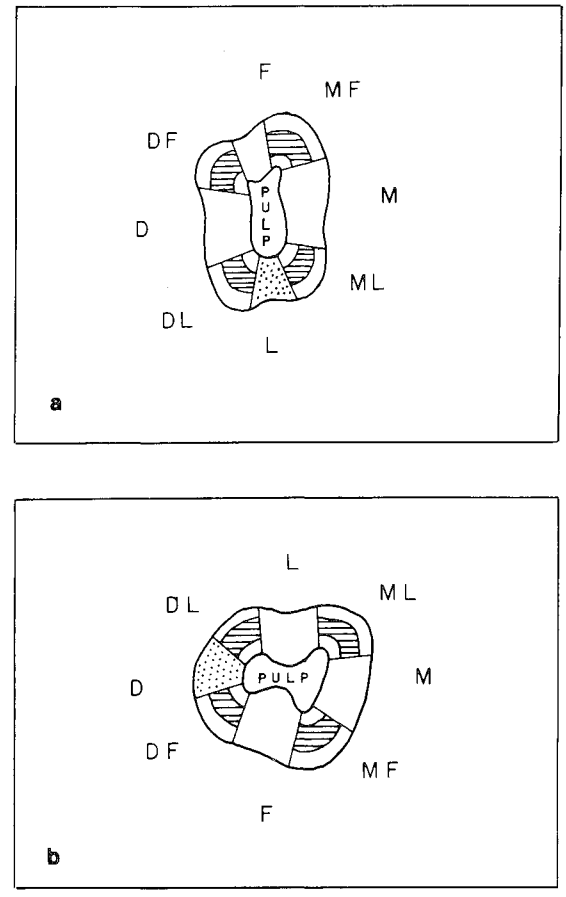

FIG. 4. *The favorable locations for pins in (a) maxillary molars and (b) mandibular molars are indicated by the lined areas. The cross sections were traced from photographs of representative specimens at the cervical line, the level where most pinholes are started. The dotted areas at the lingual of the maxillary molar and the distal of the mandibular molar have adequate dentin for pins, but the curvature of the roots just apical to the cervical line complicates the placement of pins.*

This article is based on a thesis submitted for the degree of Master of Science in Dentistry at the University of Washington, School of Dentistry, 1970.

The opinions or assertions contained herein are those of the author and are not to be construed as official or reflecting the views of the Dental Corps or the Department of the Navy.

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(Accepted 2 August 1978)

Marginal Leakage of Amalgam Alloys with High Content of Copper: A Laboratory Study

Leakage around amalgams with high content of copper is reduced more slowly than that around amalgams of traditional alloy, but by the end of two years restorations of both types of alloy have virtually ceased leaking.

JAMES T ANDREWS • JOHN H HEMBREE, JR

Summary

Amalgam restorations of Velvalloy, Micro II, Optaloy II, Dispersalloy, Sybraloy, Cupralloy, Aristaloy CR, Indiloy, and Tytin were tested for marginal leakage to a radioisotope after thermal cycling. Leakage diminished more slowly with alloys of high content of copper, but at the end of two years leakage of both types of alloy had virtually ceased.

Introduction

Amalgam alloys attracting interest today are those with a high content of copper. Amalgams of these alloys have higher compressive strength, lower static-creep, and less Υ_2-phase than do amalgams of traditional alloys (Eames & MacNamara, 1976). A decrease in Υ_2-phase is related to a decrease in corrosion (Duperon, Nevile & Kasloff, 1971). Since deposition of corrosion products from amalgam into the space between restoration and tooth in time reduces leakage around the amalgam (Phillips, 1973), the question must be asked: "What will be the pattern of leakage around the new amalgams with high content of copper?"

Previous studies have indicated that marginal leakage of amalgams of traditional alloys and of alloys with high content of copper are essentially the same (Andrews & Hembree, 1975; 1978). In those studies, however, only a small number of alloys with high content of copper were examined. The purpose of this study was to compare the marginal leakage of a greater number of these new alloys.

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Materials and Methods

Nine amalgam alloys were included in the study (Table 1).

Class 5 cavities were prepared with No 35 inverted cone burs in 270 sound, extracted, premolar and canine teeth, which had been stored in tap water after extraction. No varnish was used beneath any of the restorations. The ratios of mercury to alloy used were those recommended by the manufacturers.

Table 1. Alloys Investigated

Alloy	Manufacturer
Traditional	
Velvalloy	S S White Philadelphia, PA 19102
High Copper	
Micro II	L D Caulk Co Milford, DE 19963
Optaloy II	L D Caulk Co Milford, DE 19963
Dispersalloy	Johnson & Johnson East Windsor, NJ 08520
Sybraloy	Kerr Mfg Co Romulus, MI 48174
Cupralloy	Star Dental Mfg Co Valley Forge, PA 19482
Aristaloy CR	Baker Dental Co Carteret, NJ 07008
Indiloy	Shofu Dental Corp Menlo Park, CA 94025
Tytin	S S White Philadelphia, PA 19102

Thirty specimens of each alloy were prepared and stored in distilled water at 37 °C. Before testing, each specimen was dipped alternately in water at 4 °C and 58 °C, one minute in each, for 100 cycles. Marginal leakage was determined by the presence of a radioactive isotope, ^{45}Ca, between tooth and restoration as shown on an autoradiograph (Swartz & Phillips, 1961). Each specimen remained for two hours in a solution of $^{45}CaCl_2$ (concentration 0.1 $mCi \cdot ml^{-1}$, pH 7). Before the specimens were placed in the radioactive solution they were carefully sealed with a combination of nail polish and tin foil. After the specimens were removed from the solution the tin foil was removed. They were then brushed with a detergent and sectioned longitudinally through the restoration by grinding wet on a wheel of aluminum oxide. The sectioned surface was brushed with detergent and placed on an ultraspeed, periapical x-ray film for 17 hours to produce an autoradiograph. The films were processed in an automatic machine. Marginal leakage was tested at one day, three months, six months, one year, a year and a half, and two years. Five specimens of each alloy were tested at each interval of time. Leakage was evaluated on the following scale:

0 = no evidence of isotope between tooth and amalgam
1 = evidence of penetration of isotope between tooth and amalgam
2 = evidence of isotope along the cervical and incisal or occlusal walls but no penetration to the axial wall
3 = evidence of penetration of isotope to the axial wall

Results

The marginal leakage of the amalgams is shown in Table 2. Of the 270 autoradiographs, three were processed improperly and are indicated as missing. Typical autoradiographs are shown in Figures 1 and 2.

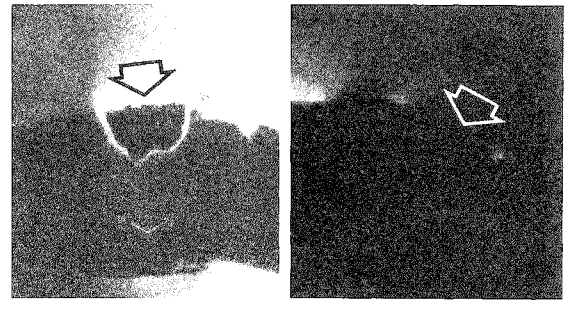

FIG 1. *Typical autoradiographs. Arrows indicate restorations and white lines indicate leakage. (a) Velvalloy after one day, (b) Velvalloy after two years.*

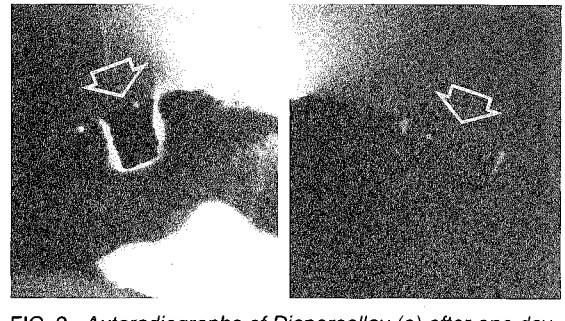

FIG 2. *Autoradiographs of Dispersalloy (a) after one day, and (b) after two years.*

Table 2. Marginal Leakage of Amalgams

Traditional

	0	1	2	3
Velvalloy				
1 day			1	4
3 mos			1	4
6 mos			2	3
1 yr		2	2	1
1½ yrs (one missing)	3	1		
2 yrs	4		1	

High Copper

	0	1	2	3
Micro II				
1 day			5	
3 mos			3	2
6 mos			1	4
1 yr (one missing)			2	2
1½ yrs			5	
2 yrs	2	3		
Dispersalloy				
1 day			2	3
3 mos				5
6 mos				5
1 yr				5
1½ yrs (one missing)		4		
2 yrs	3	1	1	
Cupralloy				
1 day				5
3 mos				5
6 mos			1	4
1 yr				5
1½ yrs			5	
2 yrs	2	2	1	
Indiloy				
1 day			2	3
3 mos				5
6 mos				5
1 yr			2	3
1½ yrs			4	1
2 yrs	3	2		

	0	1	2	3
Optaloy II				
1 day			1	4
3 mos				5
6 mos			1	4
1 yr				5
1½ yrs				5
2 yrs	2	2	1	
Sybraloy				
1 day			4	1
3 mos				5
6 mos			1	4
1 yr			3	2
1½ yrs			5	
2 yrs	4	1		
Aristaloy CR				
1 day				5
3 mos			1	4
6 mos			2	3
1 yr			5	
1½ yrs			5	
2 yrs	3		2	
Tytin				
1 day			1	4
3 mos				5
6 mos				5
1 yr			5	
1½ yrs		2	3	
2 yrs	3	1	1	

The traditional alloy, Velvalloy, demonstrated substantial leakage at one day, three months, and six months. Progressive reduction in leakage was noted at one year and at a year and a half. At the end of two years, four of the five restorations demonstrated no leakage.

All the alloys with high content of copper demonstrated substantial marginal leakage at one day, three months, six months, one year, and a year and a half. At two years, however, the leakage of all of these alloys was reduced markedly.

At the end of two years the leakage of the traditional alloy and the alloys with high content of copper were about the same.

Discussion

Previous studies demonstrated the virtual elimination of marginal leakage of both traditional alloys and alloys with high content of copper after a year. In the present study, two years were required to reduce leakage almost completely. In one of the previous studies (Andrews & Hembree, 1975) the earlier cessation of leakage may have occurred because the teeth were not subjected to thermal cycling. In the other study (Andrews & Hembree, 1978), an animal study, the presence of proteinaceous material could possibly explain an earlier decrease in leakage.

Conclusion

Leakage around amalgams with high content of copper does not subside as soon as that around amalgams of traditional alloy. This is probably because amalgams with high content of copper corrode less.

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(Accepted 4 December 1978)

Fluoride Supplemented Dental Amalgam

Fluoride incorporated in dental amalgam is not effective in reducing susceptibility to recurring caries because the fluoride is released in insignificant amounts.

IRA L SHANNON • JAMES T MILLER

Summary

Cylinders of dental amalgam containing 1.5% stannous fluoride were placed in deionized water and the rate of release of fluoride was determined at intervals ranging from one hour to 112 days. During the first hour the amalgam lost an average of 427.0 μg of fluoride to the water. The rate of release of fluoride decreased precipitously and over the second eight weeks of the experiment the mean loss of fluoride was only 0.30 μg per day. After the first day the rate of loss of fluoride was negligible and below a level that would protect tooth surfaces. These results, coupled with those in the literature on release of fluoride, compressive strength, and resistance to corrosion, contraindicate the clinical use of dental amalgam supplemented with fluoride.

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Introduction

We have known for many years that caries seldom recurs around restorations of silicate cement, even though the restorations deteriorate and the margins of the cavities are exposed for long periods of time. We know also that this resistance to caries results from a lowering of the solubility of enamel by fluoride leaching from the filling material (Phillips & Swartz, 1957; Platt & Norman, 1960; Norman, Phillips & Swartz, 1960). Restorations of amalgam, on the other hand, fail more often from recurring caries than from physical failure of the material, 68% compared with 9% (Richardson & Boyd, 1973). It is only natural, therefore, that attempts should have been made to reduce the incidence of caries around amalgams by incorporating fluoride in that material. Such studies have included amalgam to which has been added calcium fluoride (Innes & Youdelis, 1966; Fazzi, Vieira & Zucas, 1977), sodium fluoride (Custer & Coyle, 1970; Forsten, 1976), amine fluoride (Bettac-Mollin, Riethe & Steffl, 1972), and stannous fluoride (Minoguchi, Yoshiaki & Tamai, 1967; Buonocore & Tani, 1968; Jerman, 1970; Custer & Coyle, 1970; Bettac-Mollin & others, 1972; Hurst & Von Fraunhofer, 1978). These studies have not provided uniform recommendations for the potential value of amalgam containing fluoride. Moreover, there is controversy over

the extent to which fluoride is released from set amalgam. The present study was designed to monitor the rate of withdrawal of fluoride from amalgam supplemented with stannous fluoride over a period of 16 weeks in deionized water.

Materials and Methods

Crystals of stannous fluoride were added to an alloy (Micro II, L D Caulk Co, Milford, DE 19963, USA) in a quantity that would provide a concentration of 1.5% stannous fluoride when the amalgam was prepared according to the instructions of the manufacturer. The amalgam was condensed into cylinders, 5 x 11 mm, with approximately the same pressure as used in the mouth. The tests were conducted on the unpolished cylinders.

Each of 10 such cylinders of amalgam was placed in 2.0 ml of deionized water. At specified intervals the cylinders were removed from the water and the water was reserved for analysis. The individual cylinders were then rinsed, allowed to dry in air, and placed in 2.0 ml of fresh water. The test intervals were 1, 2, 4, and 8 hours; 1, 4, and 7 days; and 2, 4, 8, and 16 weeks. A buffer was added to the samples of water to adjust ionic strength, and the activity of the fluoride ion was measured by a specific-ion meter. Means and standard deviations for the loss of fluoride to water were calculated for the 10 specimens.

Fluoride Withdrawal from Set Amalgam (micrograms per hour)

Time period	Fluoride withdrawn μg/h	
	Mean	SD
0–1 hour	427.0	90.05
1–2 hours	70.4	15.71
2–4 hours	30.8	6.14
4–8 hours	16.1	3.56
8–24 hours	11.1	2.61
1–4 days	3.2	1.26
4–7 days	2.0	0.75
1–2 weeks	1.0	0.33
2–4 weeks	0.2	0.09
4–8 weeks	0.1	0.03
8–16 weeks	0.0	0.10

Results

The hourly rates of withdrawal of fluoride from the specimens of amalgam containing stannous fluoride are shown in the table. The loss of fluoride in the initial exposures to water was relatively high. The first hour of exposure of the amalgam to water removed approximately as much fluoride as was removed during the last 108 days of the experiment. Loss of fluoride to the water over the first 24 hours was some 2670 times more than that lost per 24 hours over the second eight weeks of the experiment. During days 2, 3, and 4 an average of 75.6 μg of fluoride was released per day; days 5, 6, and 7—47.0 μg; days 8 through 14—23.0 μg; days 15 through 28—6.1 μg; days 29 through 56—1.8 μg; and days 57 through 112—0.30 μg per day.

In the light of the very small amounts of fluoride withdrawn after the first day of exposure, the initial figures appear to be very high. That this is purely relative is seen clearly when actual weights of fluoride are considered. During the first 24 hours of exposure, the specimens of amalgam released about 0.8 mg of fluoride. This is the amount of fluoride that an individual would ingest by drinking one liter of water containing fluoride at a concentration of eight parts per million.

Discussion

During the early hours of the experiment the release of fluoride was relatively high but subsequent results made it clear that these high values represented simply dissolution of stannous fluoride from the surface and outermost layer of the amalgam. After the first day the loss of fluoride was miniscule and below

the level that would protect the surface of a tooth. Treating the walls of the prepared cavity with a solution of stannous fluoride before inserting the amalgam would be more effective.

A further problem is the diversity of results on the effect of added fluorides on the physical characteristics of the amalgam. Although some studies have reported no deleterious effects (Jerman, 1970; Innes & Youdelis, 1966), others have reported substantial decreases in compressive strength (Buonocore & Tani, 1968; Custer & Coyle, 1970; Fazzi & others, 1977; Hurst & Von Fraunhofer, 1978). Stoner, Senti & Gileadi (1971) found that the incorporation of stannous fluoride into dental amalgam induced a decided deterioration in resistance to corrosion and concluded that this material was not suitable for dental restoration.

Conclusion

The results of this study, showing a negligible release of fluoride from amalgam containing fluoride, coupled with reports of other studies on the release of fluoride and with reports of the deleterious effects of fluoride on compressive strength of amalgam and its resistance to corrosion, contraindicate the use of amalgam supplemented with fluoride for dental restorations.

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(Accepted 16 February 1979)

DENTAL EDUCATION

Trends in Operative Dentistry Skills

Many examiners for dental licensure believe that among recent dental graduates the skills in operative dentistry have declined.

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Summary

A random sample of past and present members of boards of dental examiners responded to a questionnaire about their perceptions of qualitative changes in the performance of applicants for licenses. Two-thirds of all respondents believed that during their tenure as examiners the skills in operative dentistry of recent dental graduates *decreased*.

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Introduction

The quality of the technical aspects of dentistry performed by recent dental graduates has been questioned. Concern over the trend has intensified in recent years as new subjects have entered the dental curriculum and competed for course time that had traditionally been devoted to restorative dentistry. Discussion of the alleged decline in the clinical abilities of recent graduates appears frequently in the dental literature (Alpert, 1973; Brinker, 1974; Butts, 1975; Fetterman, 1974; Grainger, 1977; Hamilton, 1976; Romano, 1976; Wilson, 1972) and comments are often accompanied by statements indicating the need for additional data.

This article presents the results of a survey of members of boards of dental examiners. Responses to a mailed questionnaire were used to analyze the changes in abilities of recent dental graduates.

Methods

The questionnaire was mailed to 260 members, past and present, of boards of dental examiners in the 50 states, Washington, DC, and Puerto Rico. Three current members and two

past members were selected at random from lists of board members in each state or region. The questionnaire comprised the following:

1. A few questions on the background of the examiner.
2. A general question: In your opinion has the quality of the performance of recent graduates, as demonstrated on board examinations you have administered, changed significantly during your tenure on the board?
3. Questions on specific areas of dental skills. Board members were asked to indicate their attitudes on changes within each area by checking responses on a Likert scale.

Results

Of the 260 questionnaires mailed, 119 usable responses (46%) were returned. The respondents represented 44 states and 33 dental schools. Of the 119 respondents, 107 were members of the state boards and 73 members of regional boards. There were 106 general practitioners and 13 specialists. The average time served on boards of examiners was 5.4 years. Thirty-eight members were appointed during 1967 or earlier, 41 appointed between 1968 and 1971, and 40 between 1972 and 1975.

Fifty-eight (49%) examiners believed that the quality of the performance of recent graduates had changed significantly, 52 (44%) believed that it had not, and nine (7%) did not respond.

The perceptions about trends in specific areas are presented in Table 1. A significant reduction in skills is associated with operative dentistry. Two-thirds of all respondents believed that skills in operative dentistry had decreased markedly or slightly during their association with a board of dental examiners. Reductions in skills in prosthodontics, both fixed and removable, were identified by slightly less than two-fifths of the respondents. However, when the responses of examiners who did not evaluate prosthodontics were deleted

Table 1. Trends in Clinical Skills Observed by Examiners for Dental Licensure. Number (n) of Examiners and Percent (%).

Skill	Decreased Markedly	Decreased Slightly	Remained the Same	Increased Slightly	Increased Markedly	Not Evaluated
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Operative dentistry	24 (20.9)	53 (46.1)	27 (23.5)	6 (5.2)	1 (0.9)	4 (3.5)
Fixed prosthodontics	16 (14.0)	28 (24.6)	22 (19.3)	8 (7.0)	2 (1.8)	38 (33.3)
Removable prosthodontics	16 (14.2)	28 (24.8)	27 (23.9)	3 (2.7)	2 (1.8)	37 (32.7)
Periodontics	4 (3.5)	7 (6.2)	19 (16.8)	35 (31.0)	9 (8.0)	39 (34.5)
Diagnosis and treatment planning	6 (5.2)	22 (19.0)	31 (26.7)	40 (34.5)	6 (5.2)	11 (9.5)
Radiographic interpretation	5 (4.3)	14 (12.0)	61 (52.1)	18 (15.4)	7 (6.0)	12 (10.3)
Radiographic technique	6 (5.2)	20 (17.4)	41 (35.7)	14 (12.2)	3 (2.6)	31 (27.0)
Oral pathology	1 (0.9)	10 (8.5)	37 (31.6)	37 (31.6)	9 (7.7)	23 (19.7)
Oral surgery	11 (9.7)	4 (3.5)	21 (18.6)	1 (0.9)	2 (1.8)	74 (65.5)
Pedodontics or orthodontics	2 (1.8)	3 (2.6)	20 (17.5)	11 (9.6)	4 (3.5)	74 (64.9)
Basic biologic science knowledge	0 (0.0)	5 (4.3)	38 (32.8)	27 (23.3)	13 (11.2)	33 (28.4)

from the computations, 57.9% of the examiners perceived that skills in fixed and removable prosthetic dentistry had decreased.

A tendency toward improved ability was perceived in periodontics, diagnosis and treatment planning, oral pathology, and in the knowledge of basic biologic science. When the figures were adjusted by deleting responses from board members that did not evaluate these areas, slight or marked improvement was noted in periodontics by 59.4% of the examiners, in diagnosis and treatment planning by 43.8%, in oral pathology by 48.9%, and in basic biologic science by 48.1%.

A comparison of the responses on the ability of candidates in specific procedures of operative dentistry indicated a decline in certain technical skills and little change in others. Poor technic was identified in relation to amalgam restorations (Table 2). Criticism of cavity preparations centered on excessive depth and width, inadequate retention, and marring of adjacent teeth with burs. A relatively high incidence of faulty proximal contact was also cited. Similar criticisms were reported with cast gold restorations (Table 3), and restorative therapy was further compromised by poor fit of castings and incorrect occlusion. Fewer boards use direct filling gold as a test of skill than use amalgam or cast gold (Table 4); however, examiners noted poorly prepared cavities and faulty restorations with direct filling gold.

Examiners were asked to classify skills in traditional procedures of operative dentistry demonstrated by recent graduates as "improved, worsened or remained the same" during their tenure as board members (Table 5). In no case did a majority of respondents indicate an improvement in any of these skills.

Table 2. Occurrence of Faulty Operative Techniques: Amalgam Restorations. Number (n) of Examiners and Percent (%).

Problems Seen by Examiners	Often *n* (%)	Seldom *n* (%)	Almost Never *n* (%)	Not Observed *n* (%)
Cavity preparation too deep	83 (70.9)	25 (21.4)	7 (6.0)	2 (1.7)
Cavity preparation too shallow	46 (40.0)	48 (41.7)	19 (16.5)	2 (1.7)
Retentive form too deep	33 (28.4)	46 (39.7)	33 (28.4)	4 (3.4)
Retentive form too shallow	60 (52.6)	36 (31.6)	15 (13.2)	3 (2.6)
Preparations too wide faciolingually	50 (42.7)	48 (41.0)	17 (14.5)	2 (1.7)
Cusps unduly weakened	51 (43.2)	50 (42.4)	13 (11.0)	4 (3.4)
Mechanical exposure of pulp	24 (20.3)	64 (54.2)	28 (23.7)	2 (1.7)
Caries remaining	32 (26.9)	61 (51.3)	24 (20.2)	2 (1.7)
Adjacent teeth marred with bur	58 (49.2)	46 (39.0)	12 (10.2)	2 (1.7)
Anatomy improperly recreated in amalgam (proximal)	49 (42.2)	54 (46.6)	11 (9.5)	2 (1.7)
Anatomy improperly recreated in amalgam (occlusal)	42 (35.6)	58 (49.2)	16 (13.6)	2 (1.7)
Proximal contact absent in amalgam (class 2)	53 (44.5)	51 (42.9)	13 (10.9)	2 (1.7)
Occlusion inadequate	24 (20.3)	65 (55.1)	27 (22.9)	2 (1.7)

Table 3. Occurrence of Problems in Operative Dentistry: Cast Gold Restorations. Number (n) of Examiners and Percent (%).

Problems Seen by Examiners	Often n (%)	Seldom n (%)	Almost Never n (%)	Not Observed n (%)
Cavity preparation too deep	54 (47.8)	38 (33.6)	14 (12.4)	7 (6.2)
Cavity preparation too shallow	31 (27.2)	51 (44.7)	25 (21.9)	7 (6.1)
Proper cavosurface bevels	42 (37.2)	44 (38.9)	20 (17.7)	7 (6.2)
Cusps unduly weakened	41 (36.0)	51 (44.7)	13 (11.4)	9 (7.9)
Inadequate reduction of cusps	32 (28.6)	49 (43.8)	18 (16.1)	13 (11.6)
Mechanical exposure of pulp	14 (12.3)	56 (49.1)	35 (30.7)	9 (7.9)
Caries remaining	20 (17.5)	53 (46.5)	32 (28.1)	9 (7.9)
Faulty marginal fit of casting	65 (56.5)	37 (32.2)	3 (2.6)	10 (8.7)
Occlusion improperly adjusted	53 (46.9)	38 (33.6)	13 (11.5)	9 (8.0)
Restoration anatomically incorrect	40 (35.1)	47 (41.2)	17 (14.9)	10 (8.8)

Discussion

The results of the survey suggest that the performance of dental graduates has changed over time, as perceived by examiners for dental licenses. Operative dentistry was identified as an area where performance of recent graduates has declined. The results of this study lead to the conclusions that skills in operative dentistry have not improved in recent years, and that there is room for improvement even though better methods of education, refined instruments, and advances in materials would lead the casual observer to believe that an improvement in the ability of dentists to treat dental disease is possible if not already a reality.

A fundamental concept of preventive dentis-

Table 4. Occurrence of Problems in Operative Dentistry: Direct Filling Gold Restorations. Number (n) of Examiners and Percent (%).

Problems Seen by Examiners	Often n (%)	Seldom n (%)	Almost Never n (%)	Not Observed n (%)
Retention form too deep	30 (26.1)	39 (33.9)	20 (17.4)	26 (22.6)
Retention form too shallow	48 (42.1)	29 (25.4)	11 (9.6)	26 (22.8)
Enamel margins poorly finished in preparation	61 (53.0)	24 (20.9)	5 (4.3)	25 (21.7)
Condensation (compaction) technique poor	68 (59.1)	14 (12.2)	8 (7.0)	25 (21.7)
Finishing technique poor	62 (54.4)	20 (17.5)	7 (6.1)	25 (21.9)
Porosity in restoration	65 (57.5)	22 (19.5)	2 (1.8)	24 (21.2)

Table 5. Changes in Performance of Skills: Operative Dentistry. Number (n) of Examiners and Percent (%).

Skill	Improved *n* (%)	No Change *n* (%)	Worsened *n* (%)	Not Observed *n* (%)
Cavity preparation for amalgam	12 (10.3)	42 (36.2)	57 (49.1)	5 (4.3)
Cavity preparation for cast gold restoration	13 (11.3)	42 (36.5)	52 (45.2)	8 (7.0)
Class 5 cavity preparation for gold foil	8 (7.1)	30 (26.5)	43 (38.1)	32 (28.3)
Class 3 cavity preparation for gold foil	3 (2.6)	31 (26.7)	48 (41.4)	34 (29.3)
Cavity preparation for resin or composite resin	5 (4.5)	43 (39.1)	12 (10.9)	50 (43.6)
Amalgam condensation and carving	12 (10.2)	63 (53.4)	38 (32.2)	5 (4.2)
Amalgam polishing	8 (6.9)	48 (41.4)	21 (18.1)	39 (33.6)
Cast gold restorations	10 (8.8)	57 (50.0)	36 (31.6)	11 (9.6)
Class 5 gold foil restorations	4 (3.5)	39 (34.5)	38 (33.6)	32 (28.3)
Class 3 gold foil restorations	5 (4.4)	34 (30.1)	42 (37.2)	32 (28.3)
Diagnosis	36 (31.6)	55 (48.2)	13 (11.4)	10 (8.8)
Rubber dam application	15 (12.8)	57 (48.7)	32 (27.4)	13 (11.1)
Caries identification	13 (11.3)	69 (60.0)	25 (21.7)	8 (7.0)
Manipulation of restorative materials	8 (7.0)	69 (60.0)	25 (21.7)	13 (11.3)
Use of liners and bases	17 (14.7)	62 (53.4)	26 (22.4)	11 (9.5)
Understanding of selection of liners and bases	20 (17.2)	57 (49.1)	25 (21.6)	14 (12.1)
Caries removal	9 (7.7)	70 (59.8)	33 (28.2)	5 (4.3)
Understanding of occlusion	30 (26.3)	53 (46.5)	22 (19.3)	9 (7.9)
Ability to perform laboratory procedures	2 (1.8)	34 (29.8)	57 (50.0)	21 (18.4)
Creation of correct tooth morphology	0 (0.0)	75 (65.8)	33 (28.9)	6 (5.3)
Anesthetic injection	14 (12.1)	67 (57.8)	6 (5.2)	29 (25.0)
Patient management	28 (23.9)	69 (59.0)	7 (6.0)	13 (11.1)
Organization of equipment	13 (11.2)	65 (56.0)	29 (25.0)	9 (7.8)

try is that dental disease, once diagnosed, must be effectively treated to prevent further deterioration in oral health. Regardless of the sophistication of restorative materials and instruments, dental treatment performed by poorly skilled dentists will lead to recurrent or iatrogenic dental disease caused by cavity preparations that needlessly encroach upon the pulp, undermined enamel at cavosurface margins, deficient proximal contours, ill-fitting castings, poorly condensed pure gold restorations, and faulty occlusion.

The results of this survey indicate clearly that there is room for improvement in the skills of dental graduates, particularly in restorative dentistry. Dental educators would be well advised to note the trend identified by examiners for dental licenses and take the steps necessary to correct deficiencies.

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(Accepted 27 November 1978)

OPERATIVE DENTISTRY, 1980, 5, 20–23.

A Survey of the Teaching of Compacted Gold

The teaching of restorations of compacted gold has declined as have clinical skills of recent graduates. These two trends may be directly correlated.

RALPH L LAMBERT

Summary

A questionnaire on the teaching of compacted gold was mailed to the chairman of operative dentistry at each dental school in the United States and Canada. Sixty-two percent of the respondents believe that this restoration should be within the capability of a general dentist, yet the responses support the contention that less emphasis is being placed on the compacted gold restoration at many dental schools. The primary reason for the decline in teaching the technique of compacted gold is the pressure of the ever-expanding dental curriculum.

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Introduction

Opinions differ widely about the value of teaching the compacted gold restoration in today's undergraduate curriculum. Despite their strenuous objections, most departments of operative dentistry during the past two decades have been subjected to serious reductions in the amount of curriculum time allocated to operative dentistry. For various reasons, many dental educators seriously question the need for teaching the compacted gold restoration to undergraduates and this procedure has been the first to succumb to the pressures on the curriculum (Marsh & others, 1974). To ascertain the present emphasis placed on this restoration in training dental students, a question-

naire was sent to the chairman of operative dentistry of each dental school in the United States and Canada. A summary of the results of this survey is presented in this paper.

Method

In April 1978, a questionnaire was mailed to each department of operative dentistry in the United States and Canada. A follow-up request was mailed in July 1978 to those schools that failed to respond. This survey consisted of eight questions and an opportunity to include comments (see sample). Although questions 2 through 5 requested the respondent to qualify his answer by identifying the importance or frequency of multiple answers, numerous respondents made no distinction between these multiple answers. The values reported in this summary, therefore, represent a pure numerical tabulation of the answers.

Results

Sixty-three responses were received from a total of 68 requests. Although only five schools do not teach compacted gold restorations, at 18 other schools clinical experience in compacted gold is optional. The 40 schools that require clinical experience in compacted gold represent 63% of the total responses. This is a significant decrease from the 75% reported five years earlier (Marsh & others, 1974). Eight schools teach the use of only one type of cohesive gold and 14 schools teach only one method of compaction. Most of the schools teach the use of a combination of materials and of techniques of compaction.

As expected, responses about clinical requirements varied widely. The highest requirement that was reported included three class 1, six class 2, six class 3, and six to eight class 5 restorations; on the other hand, 11 schools reported a requirement of five or less. The average of those schools with requirements in compacted gold was 5.3 preclinical and 9.4 clinical procedures.

The trapezoid outline form for class 5 cavities is advocated by most schools; however, opinion about the teaching of incisal retention seems generally divided. Numerous types of class 3 preparation are taught, with most schools teaching more than one type. The lingual approach of Loma Linda is the design of class 3 cavity preparation most frequently used.

Twenty years ago, Simon (1958) categorized the teachers of gold foil as either the Zealot, the Compromising, or the Antagonistic. The comments of the respondents indicate that these divisions are still appropriate. One respondent defends his antagonistic position with the comment that "treatment planning aimed at the use of one material is prostituting the whole concept of patient care." At the other end of the spectrum, one chairman states that "since the material has no equal in certain applications we would be remiss in not teaching its use to the students whether or not they choose to use it in practice."

Several respondents expressed concern over pressure from the curriculum committee to eliminate the teaching of compacted gold, especially in those states that no longer require a compacted gold restoration as part of the state board examination. Most of the respondents indicated that the teaching of compacted gold had a direct influence on the quality of care the student is capable of providing. One such response states that "the skill and art of precision dentistry rests on the exacting demands of compacted gold."

Discussion

The results of this survey seem to reinforce the suspicion that the teaching of compacted gold restorations is on the decline. It is curious to note that the technical skill of recent graduates is also on a downward trend (Smith, Bomberg & Bauer, 1980). Because of the discipline and precision required for the compacted gold restoration, I suspect these trends are directly correlated.

Several respondents to this survey stated that the clinical time allocated to operative dentistry has been curtailed to the point that "it would seem wrong to use valuable curriculum time teaching a treatment procedure that knowingly will be used very little, if at all, by our students when they enter private practice." A logical extension of this philosophy would also eliminate the teaching of the cast inlay, the three-quarter crown, and even the rubber dam. If the criteria for deciding which subjects we teach our students is based upon how much this knowledge is used in private practice, then

Sample Questionnaire

1. Is the compacted gold restoration included as part of the operative dentistry curriculum at your school?

YES	58*
NO	5

2. If compacted gold is not a part of your curriculum, which of the following reasons most accurately describes your opinions of this restoration?

Other restorative materials are superior.	
Not economically feasible in private practice.	2
Too difficult for undergraduate curriculum.	
Patients will not accept compacted gold.	2
Too injurious to the pulp.	
Inadequate faculty expertise.	3
Not enough curriculum time available.	5
Other.	2

3. If compacted gold restorations are part of your curriculum, which of the following statements most accurately describes your reasons for including this procedure?

Most biologically acceptable restorative material.	21
Greater longevity than any other restoration.	37
Teaches skills beyond those required for other materials.	43
Should be a part of the general dentist's capabilities.	39
Enhances reputation of operative dentistry department.	6
Required by state board.	28
Other.	5

4. Which of the following materials are included in your curriculum?

	Total	Primary	Exclusive
Hand rolled gold foil pellets.	4	2	2
Commercially prepared gold foil pellets.	47	21	
Laminated gold foil.	3		
Mat gold.	35	2	
Mat foil.	8	2	1
Electraloy RV.	23	4	4
Powdered Gold (Goldent).	40	14	1

5. What type of compaction do you teach?

	Total	Primary	Exclusive
Hand malleting.	16	1	1
Hand compacting (no malleting).	35	4	4
Mechanical condenser (spring loaded).	8	1	
Pneumatic condenser.	13	2	
Electronic condenser.	50	21	9

6. Please indicate the appropriate number of compacted gold restorations required of each student, that is, minimum requirements.

	Preclinical		Clinical	
Class 1	_____		_____	
Class 2	_____		_____	
Class 3	_____	Average = 5.3	_____	Average = 9.4
Class 4	_____		_____	
Class 5	_____		_____	

7. What type of Class 5 preparation do you teach?

Trapezoid with gingival retention only (Ferrier).	19
Trapezoid with gingival and incisal/occlusal retention.	24
Kidney shape (G V Black).	4
No specific form, outline dictated by lesion.	9
Other.	1

8. What type of Class 3 preparation do you teach?

Facial approach, Ferrier design.	17
Facial approach, G V Black design.	7
Lingual approach, Jeffery design.	12
Lingual approach, Loma Linda design.	23
Lingual approach, slot design (Ingraham).	14
Inciso-lingual, Medina design.	4
Other.	3

9. Please add any additional comments regarding the teaching of compacted gold.

_____

*Twenty responses are elective courses only.

why do we teach them to polish amalgam restorations, expose intraoral radiographs, or perform an oral prophylaxis?

The compacted gold restoration teaches the student a standard of excellence seldom, if ever, achieved with any other restorative material. Competent gold foil operators have learned to expect four times the service from a compacted gold restoration as from a composite resin. At an average fee of three times that received for a composite, the compacted gold is certainly an economic restoration (Christensen, 1971).

In my opinion, any dental student that is denied the opportunity to develop the operative skills associated with the compacted gold restoration, due to a lack of enthusiasm or ability of his operative instructors, has been denied the opportunity to reach his full potential as a restorative dentist.

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(Accepted 8 January 1979)

PRODUCT REPORT

Dental Amalgam: Clinical Behavior up to Eight Years

After eight years of clinical service, an alloy high in copper exhibited less fracture at the margins and had less fracture of the bulk of the restoration than did traditional amalgam alloys.

J W OSBORNE • P P BINON
E N GALE

Summary

An analysis of amalgam restorations of Dispersalloy, Aristaloy, and Micro Cut showed that Dispersalloy had the least fracture of margins and the least gross fracture, and Micro Cut had the most, indicating that replacement dentistry can be drastically reduced by a good choice of alloy.

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Reprint requests to Dr Osborne

Published concurrently in the *Journal of the Academy of General Dentistry*

INTRODUCTION

In late 1970 a clinical project was begun at Indiana University to investigate the relation of marginal fracture of restorations to certain physical properties of amalgam (Binon, 1972). The alloys used in the study were an alloy with high content of copper, Dispersalloy (Unitek Corporation, now manufactured by Johnson & Johnson Dental Products, East Windsor, NJ 08520, USA), and two traditional alloys, Aristaloy (Englehard Industries, Inc, Carteret, NJ 07008, USA) and Twentieth Century Micro Cut (L D Caulk Co, Milford, DE 19963, USA). An evaluation of the performance of the alloys after three years has been published (Osborne & others, 1976). This report is a further evaluation of the alloys for marginal fracture at five years and bulk fracture at six and eight years. In addition the report clarifies the role of selection of alloy as a factor in the ultimate replacement of the restoration.

METHOD

The details of the experimental method have been published (Binon, 1972; Osborne & others, 1976).

Marginal Fracture

At five years, only 11 of the 22 patients examined at three years could be located for recall. These 11 patients represented 46 of the 113 restorations examined at three years.

Photographs were taken of the restorations and the prints evaluated by two dentists. Each restoration was placed in one of six categories of increasing marginal fracture. The distribution was analyzed by Ridit (Mahler, Terkla & Van Eysden, 1973) and a χ^2 test. In addition, all photographs were ranked from best to worst and a mean and a standard deviation calculated for each material.

Bulk Fracture

Within six months to a year of the five-year recall, seven more patients were located or attended the clinic for treatment. These patients were examined and given prophylaxes and any restorative treatment needed. No restorations in the project were replaced unless the bulk of the amalgam had fractured.

Detailed clinical records were kept for each patient. The six- and eight-year data on bulk fracture were obtained from the patient's records. Not only were bulk fracture and subsequent replacement recorded, but also the extent of decay under the failed restorations was noted.

Most bulk fractures were in class 2 restorations with fracture at the isthmus, but there were failures of class 1 restorations also.

RESULTS

Marginal Fracture

The results of the Ridit analysis of the data on marginal fracture of 46 restorations after five years are shown in Table 1. To analyze the data appropriately by the χ^2 test, categories 1 & 2 and 5 & 6 were collapsed to eliminate some zeroes. Yates' correction was used with the χ^2 test. Interpretation of the results of this analysis indicates that Dispersalloy is sig-

Table 1. Distribution and Ridit Analysis of Marginal Fracture of Amalgam at Five Years

	Categories (Both Evaluators Combined)						Total Number of Restorations	Ridit Mean	Variance
	1	2	3	4	5	6			
Dispersalloy	8	19	11	2	0	0	20	.2912	.0380
Aristaloy	0	6	15	5	4	2	16	.5600	.0483
Micro Cut	0	0	2	4	8	6	10	.8217	.0183
Total	8	25	28	11	12	8	46		
Cumulative frequency	4	20.5	47	66.5	78	88	(92)		
Ridit	.0434	.2228	.5109	.7228	.8478	.9565			

A lower ridit mean equals less marginal failure.

nificantly better than Aristaloy ($\chi^2 = 20.5$, df = 3, $P < 0.001$) and Micro Cut ($\chi^2 = 46.04$, df = 3, $P < 0.001$), and that Aristaloy is significantly better than Micro Cut ($\chi^2 = 17.28$, df = 3, $P < 0.001$).

Rank ordering, shown in Table 2, produced similar results. Dispersalloy had significantly less fracturing of the margins than did Aristaloy and Micro Cut, and Aristaloy had significantly less than Micro Cut ($P < 0.01$). The agreement between examiners was high, the correlation between ranks being 0.98, which is statistically significant ($P < 0.01$).

Table 2. Rank Ordering Test on Marginal Fracture at Five Years

Amalgam	Mean Rank and SD			
	Evaluator No. 1		Evaluator No. 2	
	Mean	SD	Mean	SD
Dispersalloy	14.3	± 9.4	14.6	± 9.6
Aristaloy	25.7	± 11.9	24.9	± 11.6
Micro Cut	38.4	± 6.1	39.0	± 6.0

$r = 0.98$
$P < 0.01$

Lower mean rank equals less marginal failure.

Bulk Fracture

The results of gross fracture and replacement of the restorations for three, six, and eight years are shown in Table 3. All figures indicate accumulated data, that is, as restorations were replaced because of fracture, they were counted as restorations in the overall total. Only 11% of the restorations of Dispersalloy were replaced in eight years; this is about half the number of restorations of Micro Cut that had to be replaced in only three years. After eight years 24% of the restorations of Aristaloy had to be replaced and 51% of those of Micro Cut. At three years the difference among the materials was not statistically significant. At the end of six years, however, Micro Cut had significantly more failures than did either Dispersalloy ($\chi^2 = 5.87$, df = 1, $P < 0.02$) or Aristaloy ($\chi^2 = 6.09$, df = 1, $P < 0.02$). At six years the difference in the rates of fracture of Aristaloy and Dispersalloy was not statistically significant. However, at eight years Micro Cut had significantly more fractures than did Dispersalloy ($\chi^2 = 11.67$, df = 1, $P, < 0.001$) and Aristaloy ($\chi^2 = 4.59$, df = 1, $P < 0.05$). Only Micro Cut had a significantly greater rate of fracture at eight years than at three years ($\chi^2 = 6.07$, df = 1, $P < 0.02$).

Caries was noted under four of the eight Aristaloy restorations, under 14 of the 18 replaced Micro Cut alloys, and under none of the Dispersalloy restorations.

Table 3. Rate of Gross Fracture at Three, Six, and Eight Years

	Three Years		Six Years		Eight Years	
	Fractures	Total	Fractures	Total	Fractures	Total
Dispersalloy	3	39 (8%)	3	33 (9%)	4	36 (11%)
Aristaloy	3	36 (8%)	5	31 (16%)	8	34 (24%)
Micro Cut	8	38 (21%)	12	32 (38%)	18	35 (51%)

Fractured restorations vs. total restorations, with percentage of the total fractured shown in parentheses.

FIG 1. *The three different alloys after six years of service in one patient. Left—Micro Cut; middle—Dispersalloy; right—Aristaloy. All were placed at the same appointment.*

DISCUSSION

Marginal Fracture

The rate of fracture of the margins of the three alloys used in this study was so varied that significant differences could be detected at nine months (Binon, 1972). In fact, the five-year results could be predicted by the data at nine months. Although careful attention was given to the design of cavities and proper manipulation of the alloys, the margins of Aristaloy and Micro Cut exhibited substantial fracturing as illustrated in Figure 1.

Bulk Fracture

Perhaps the most significant finding is not the extent of breakdown of the margins at five years, but the amount of gross failure and ultimate replacement of the restorations (Figure 2). Over half the restorations of Micro Cut were replaced after eight years of service, whereas less than one-eighth of the Dispersalloy restorations were replaced. Factors such as design of cavity or manipulation of material may have played a role, but it was certainly minor compared to the alloy selected for use. This does not mean that sloppy dentistry should be encouraged; that would only increase the problem.

It is also significant to find from the patient's dental records that 50% of the amalgams of Aristaloy with a bulk fracture and 83% of those of Micro Cut had recurrent decay. Interestingly, no recurrent decay was found with restorations of Dispersalloy that had a bulk fracture. One can only surmise that high rate of marginal fracture does indeed promote recurrent decay, as suggested by Jørgensen & Wakumoto (1968). A recent clinical report confirms this finding of a relationship between marginal fracture and ultimate replacement (Goldberg & others, 1980). It may be that caries undermines the alloy; then, fortunately, the brittle,

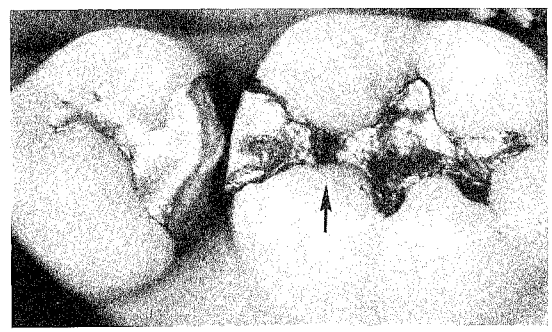

FIG 2. *Two restorations after six years of service. Dispersalloy is in the premolar and Micro Cut in the molar. Note fractured Micro Cut, which had caries under the mesial portion.*

unsupported alloy fractures, resulting in the patient's seeking treatment.

The proportion of restorations with bulk fracture in this study may be lower than that reported because the patients who returned were most likely those who needed treatment for fractured restorations and the 15 patients not retrieved at eight years may not have needed treatment. On the other hand, it should also be noted that replacement restorations were of Dispersalloy. It is possible that had Micro Cut or Aristaloy been used again, a broken restoration would have recurred, giving a higher rate of failure for those alloys.

An important historical note is that Aristaloy and Micro Cut were certified alloys at the beginning of this study but, until the revision of the American Dental Association's Specification for Amalgam in 1978, Dispersalloy did not meet specifications. Dispersalloy and Micro Cut were developed a few years apart, in the late fifties and early sixties, but Micro Cut quickly became very popular because of good promotion of sales and ease of handling. It is obvious that certification, time of development, handling characteristics, and popularity are not necessarily good criteria for selecting an alloy. In retrospect, a great disservice was thrust upon the practitioner and patient because of the lack of good clinical research.

CONCLUSIONS

Several new alloys with a high content of copper have come onto the market in the past few years. Dentists would be well advised to look to clinical studies for guidance in selecting the dental alloy to use in practice. Dentists should make every effort to select an alloy that would reduce the need to replace restorations. The difference between replacing an amalgam only once compared to seven or eight times during a patient's lifetime is enormous. Few teeth can survive multiple restorations before becoming endodontically involved or in need of a crown. Patients and practitioners do not need make-over dentistry.

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POINT OF VIEW

Let the Patient Decide

MAURICE H MARTEL

We hear it said that one of the reasons people are forced into cut-rate dental establishments is the prohibitive cost of dental treatment in many of our offices. Some dentists either treat the patient in total or refuse to treat at all. This is unfortunate, because for the patient who has never been taught the fundamentals of the control and prevention of dental disease, only minimal treatment should be performed. Inlays, crowns, bridges, and partial dentures should not be placed in any mouth in which disease is not under control. This means that the patient with low regard for dental health should receive minimal care at relatively low cost until he has mastered the technique of oral hygiene and has developed the desire to conserve his natural dentition. Most restorations will fail if placed in a mouth where disease is out of control. The patient with oral breakdown should be cared for in steps, and in the process the cost becomes a step-by-step, year-by-year approach to attaining oral health. Cost itself need not, in many instances, be the reason for accepting or rejecting treatment if total dental health is presented and a valid sequence of treatment begun. The following is an outline of a proper sequence of treatment:

1. Emergency treatment to eliminate pain and infection
2. Program to control and prevent disease, including education adequate to translate the patient's needs into desires and demands
3. Periodontal treatment, including any needed oral surgery
4. Treatment of the pulp and endodontic treatment
5. Restorative care including all forms of composite or amalgam foundations (recognizing that in the future, full crowns, onlays, etc, may replace these—but a solid base is built for the future)
6. Fixed and removable prosthetic care, including crowns and partial coverage cast restorations

Note that termination of the treatment at any step along this path results in a healthier mouth. However, if the order is materially changed, failure of the treatment is inevitable. To treat according to this outline is reasonable, scientific, understandable to patients, and economically feasible for most of them. Whenever treatment ends, and for whatever reason, be it economics, fear of treatment, or whatever, the patient will have better oral health and will not

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have wasted time and money on treatment that does not have a good chance of success.

It is unfortunate that most plans of government and other third parties do not allow benefits for control and prevention of disease because the money paid by third parties could best be spent in sponsoring and encouraging the prevention of disease. Prevention improves dental health significantly and should be the final goal of dental treatment. Some programs of third parties also limit or eliminate periodontal care. The reason frequently given for this is the lack of opportunity for surveillance and control by the third party. However there is a simple way to control these costs—by the **patient** himself.

In any system involving a third party, the patient must maintain control of the decisions that are made about his or her oral health. Programs of third parties should require the patient to pay a portion of the cost. In this way, the patient would not allow unnecessary treatment, but would most likely accept, and demand, the care that is needed. The patient would have a higher regard for the service and would accept the responsibility of properly caring for his or her oral health. Parents have learned that if the child shoulders some of the cost of his new bicycle, he will purchase it with greater care and take better care of it. This is human nature and common sense—let's use it.

For many third parties, and especially for plans sponsored by the government, dental health is measured by the number of visits, fillings, x-rays, extractions, etc. This is not health care with a goal of **better health,** but health care with a goal of statistics and money, neither of which is a valid measure of health service.

Pooled money will not buy more than unpooled money. Most third parties want to keep money so it, and they, will grow. Third parties can budget money, but cannot get more for less. Politicians want to get elected and reelected. Insurance companies want to make more money. All third parties need to make a profit. The only way they can do this is to control fees or limit service. If fees are controlled, the quality of care cannot improve, regardless of standards and systems of controlling quality. How then, can these proposed systems solve all the problems of health care as they propose to do? More money will not solve the problem.

Patients should never lose control over making decisions about their health. It is unfortunate that the buyer (the one who pays the bill) is not always the person that receives the service. The buyer in many third-party arrangements is more concerned with money than with health. All patients are concerned with their health.

Let the patient decide.

EDITORIAL OPINION

Full Coverage Restorations: Panacea or Epidemic?

WILLIAM W HOWARD

Editorial (September-October 1979) *Journal of the Academy of General Dentistry* (27) 6–7.

Computers are not an evil manifestation of modern technology designed merely to standardize all civilized life, foul up your checking account, erroneously bill you for 27 hand-painted medieval gargoyles, or generate disquieting letters about your membership maintenance status.

In a profession that is by nature fragmented, constructed, for the most part of thousands of individual dentists practicing in thousands of individual, isolated offices, computers can bring us closer together. They can remind us of things we long ago forgot about ourselves (like our continuing education records), and they can collect and analyze data that can help us get to know our far-flung colleagues a little better and make us aware of both positive and negative practice trends.

The computer, of course, is the backbone of data collection by insurance companies and other third parties, and its effective use can sometimes draw some startling profiles of our profession.

Some weeks ago I was provided with data summarizing claims submitted by dentists to a major insurance company over a six-month period. Of particular interest to me was data for restorative procedures, which I have reproduced for our readership in the table accompanying this editorial. Whether or not these figures are representative of dental practice in areas outside my own neck of the woods I do not know. But if similar studies elsewhere in the country correlate with the data presented here, I believe there is cause for concern.

What disturbs me is the low ratio of conservative cast restorations as compared with full coverage crowns: 505:7,084, or, roughly, one conservative cast restoration to every 14 full coverage crowns. Whether or not the pre-

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ponderance of full coverage crowns can be justified is, in my mind, questionable. It seems fairly likely to me that dentists are placing less emphasis on fine conservative cast restorations than they should.

I am not suggesting greater emphasis on conservative techniques as a means of cutting costs to the patient: I happen to feel that a well-designed and skillfully executed conservative casting deserves fees at least as high as those for full coverage castings. A conservative casting generally requires more time and skill than does its full coverage cousin.

Is it possible, however, that our schools are not adequately teaching and/or supporting a philosophy of conservatism in restorative procedures? Have high-speed handpieces made it so easy to prepare a full crown that more intricate (conservative) castings are now too much bother? Is it possible that fewer dentists feel pride in their personal restorative skills? It would seem that the Academy of General Dentistry, with its commitment to continuing education, might include among its membership many dentists whose skills and philosophy support conservative concepts of restorative treatment. I would be most interested to know the current objectives of participating restorative study clubs regarding conservative cast restorations versus full coverage crowns, and I invite their members to respond to my remarks.

Computerized data collection has reached a level of sophistication that makes it possible to produce performance profiles of individual dentists. And we may soon be able to benefit from examining the performance profile of the "average" dentist and comparing that profile with our own practices. There is little doubt that there are those among us who resent the potential to produce such information. But the negative response on the part of some of my colleagues toward computer analysis of this type brings to mind some of the irregular practices that have surfaced in the past, even without the aid of computers: the dentist who removed all third molars from children aged 12 and 13; the practitioner who placed "pulp caps" under all restorations; or the dentist who placed class 1 amalgam restorations in all posterior teeth of his young patients.

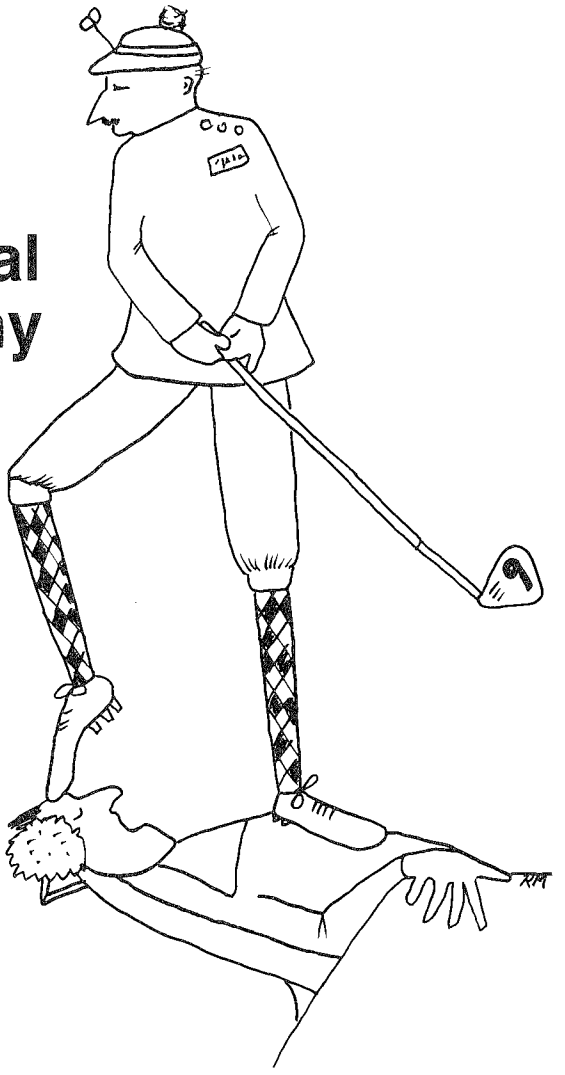
Summary of Restorative Claims Submitted over Six Months

I. Gold Casting	
a. Onlays	18
b. Inlays	
i. one surface	14
ii. two surface	86
iii. three surface	86
c. Three-quarter crowns	301
d. Full cast crowns	3,343
e. Porcelain-gold crowns	3,562
f. Porcelain-gold (semiprecious crowns)	128
g. Nonprecious crowns	51
h. Porcelain crowns	2
II. Amalgam	
a. One surface	14,533
b. Two surface	15,538
c. Three surface	7,024
d. Four surface	1,341
III. Root Canal	
a. One canal	751
b. Two canals	575
c. Three canals	1,031

My major concern, however, is not the ability of prepayment and third party programs to produce data profiles on individual dentists. Certainly, many practices vary simply because of differences in referral policies, special interests of the practitioner, specialization, etc. What does concern me is the tendency, now documented, for dentists to place full crowns routinely, rather than considering more conservative remedies.

Idiopathic Subgingival Amalgam Hypertrophy

RICHARD E LOMBARDI



Summary

A new nomenclature is submitted for the amalgam overhang. The need for further studies of the etiology is indicated. Experimental methods of removing the hypertrophic amalgam are discussed.

Introduction

The purpose of this paper is to report on recent studies of idiopathic subgingival amalgam hypertrophy, formerly known as the amalgam overhang. At the outset of the study it was believed that this condition was of iatrogenic origin, but in discussion with thousands of practitioners it was learned that not one had ever placed an overhang on an amalgam and this assumption is therefore invalid.

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RICHARD E LOMBARDI, DDS, investigative director

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Nomenclature

This new nomenclature is submitted for consideration as being more descriptive than the old term of 'overhang' and was arrived at in the following manner.

Since no definitive statement regarding the etiology of this condition can be made, it must be grouped together with the unknowns and

described as idiopathic. The term 'subgingival' is mandatory because this condition is never seen on other surfaces of the teeth except possibly in isolated instances where a similar condition is found on occlusal surfaces. In this situation, however, it is always associated with another strange amalgam anomaly in which the surface of the restoration exhibits numerous small, somewhat circular surface convolutions that bear a striking resemblance to a fingerprint. Our own current evidence indicates that the idiopathic subgingival amalgam results from the fact that even a meticulously placed and contoured amalgam restoration somehow gathers the vital life source within the tooth and begins to grow and, therefore, may be considered hypertrophic. Further investigations are needed in this area.

Classification

The hypertrophic amalgam lends itself to classification morphologically into the following divisions:

1. **The log cabin or maple syrup type:** In this type it appears that the amalgam has been poured into the cavity and allowed to flow gently down the proximal surface, much as syrup would.

2. **The ideal toothpick type:** Although there is no correlation between the toothpick and the shape of this amalgam hypertrophy, the resemblance of this toothpick in cross section to the shape of the hypertrophic amalgam makes it an "ideal" term to describe it. The contour of this amalgam proceeds gingivally in a straight line from the marginal ridge to a point beneath the tooth preparation where it makes a precise 90° turn and proceeds to the proximal surface of the tooth which it intersects at another 90° angle at a point closer to the apex than the gingival margin. There exists a subdivision in this group known as the bamboo or oriental toothpick type, which resembles the ideal toothpick type, except that because the bamboo toothpick is of a different shape, the hypertrophic amalgam seems to be going in a more crosswise direction.

3. **The retentive or double overhang type:** This type is found more often on teeth of an extreme bell-shaped contour. This hypertrophic amalgam proceeds subgingivally to a point below the tooth preparation at the gingival where it not only follows the contour of the restored tooth, but also the proximal contour of the adjacent tooth. The result is a form of an inverted "Y," which very securely locks the restoration in place.

Treatment

Because the search for a definite etiologic factor proved fruitless, attention of the investigators was directed to treatment of the condition by removing the overgrowth. An interdisciplinary approach was adopted. A periodontal team undertook a study to determine the efficacy of hypertrophic amalgam removal utilizing standard dental instruments. Because all the instruments broke before any of the hypertrophic amalgams were removed, a series of instrument modifications were undertaken. One modification was the welding of a 1″ steel bar the full length of the scaler or gold knife. This, too, produced no significant difference in effectiveness. The second step was to attach a portion of water-ski rope to the handles of the steel bar. This was used in conjunction with a steel stirrup welded to the head of the chair. By placing the cutting edge of the instrument in position on the hypertrophic amalgam and placing one foot in the stirrup to brace himself and pulling on the water-ski handles, the operator was experiencing some small degree of success; but the experiments were discontinued when the tow rope broke and the handles struck the investigator in the face, fracturing his mandible. It was interesting to note that the fracture occurred interproximally at the point where there was a double or retentive type hypertrophic amalgam that remained intact. Fixation of the fracture was accomplished by wiring the distal fragment to the hypertrophic amalgam, and intermaxillary fixation was not required.

A golfer on the investigation team was achieving some success by using a number nine golf iron and using a full back swing. The cuspidor was used as the cup and the operator attempted to chip the hypertrophic amalgam into the cuspidor. This technique is of no value in more improved offices and success varies according to the lie.

Other periodontal investigators showed that the hypertrophic amalgams may be valuable.

In some cases they function to hold the teeth in place; it was found that when the hypertrophic amalgam was removed the teeth fell out. In three cases when the hypertrophic amalgams were removed, the gingivae fell off.

The surgery department experimented with the Caldwell-Luc approach for the removal of upper hypertrophic amalgams. This is done by utilizing the standard approach through the maxillary sinus and by dissecting down to the root to the hypertrophic amalgam. This provided access for the placement of a chisel on the base of the hypertrophic amalgam. This chisel was struck sharply with the mallet and in some cases the hypertrophic amalgam was removed. In some cases the teeth were removed. Twenty-three cases suffered whiplash injuries. This technique shows great promise but is of no value on lower hypertrophic amalgams. A similar submandibular extraoral approach is being planned.

The fixed partial department became interested in the retentive qualities of this structure and studies were done to see how much force was required to remove a hypertrophic amalgam. All the conventional laboratory testing equipment was exhausted without removing any hypertrophic amalgam. Therefore, a subject's feet were shackled in steel to the bottom of an express elevator shaft and a cable attached from a hypertrophic amalgam to the bottom of the elevator car. Enough slack was left in the cable to allow the car to gain momentum before stress was placed on the hypertrophic amalgam. The experiment had to be discontinued because the steel shackles broke and the patient had to be rescued between the 23rd and 24th floors. There were no side effects other than a marked increase in the height of the subject, who looks forward to a career in professional basketball. The hypertrophic amalgam is intact.

DEPARTMENTS

Dear Woody

New Question

Dear Woody:

Should the surface of a restoration consisting of a composite with large particles of filler be polished before glazing?

Lee Cage, DMD
Mercury, OR 20059

Editor's note: Any reader with an answer to this question—or with another question—is asked to communicate as soon as possible with: Dr Nelson W Rupp, National Bureau of Standards, Dental Research Section, Washington, DC 20234

Question from Summer 1979 Issue

In preparing a typical MO cavity, particularly in a bicuspid, I often notice as the distal fossa is entered a crack appears in the distal marginal ridge, a crack which extends in a mesiodistal direction. I work with a magnifying loupe so the cracks are readily visible. This phenomenon occurs also in molars but not as frequently. I use Star Futura high-speed handpieces and sharp S S White No 556 burs. My question is: Have other dentists noticed this phenomenon and what is its cause? Also I see many more fractured cusps in patients I have treated as well as in those of other practitioners. Please comment.

Woody's Answer

The question posed by Dr Ogman is one frequently encountered when preparing a cavity and the operator is approaching a sound marginal ridge. A natural groove or fissure often extends over this marginal ridge into the occlusal embrasure. In addition to this, craze lines also are formed by the impact of high-speed #556 fissure burs cutting sound enamel. This is especially true as the bur approaches the distal or mesial wall of enamel from the internal aspect of the tooth.

There are several preventive measures the operator can observe to reduce the frequency of these cracks or craze lines, two of which follow.

1. Open these areas with a 329 or 330 bur using at least 3 ml of water per minute to cushion the shock of the bur, clear the area and clean the bur. Use the bur with a light, brush-like stroke. If you hear the handpiece slow down while cutting, you are using too much pressure. The bur should be cutting the dentin and shearing the enamel as it is pulled occlusally out of the cavity. The 329 bur has a rounded end which will form a rounded buccopulpal or linguopulpal junction. (A rounded line angle is more stress resistant than a sharp acute angle.)

2. As the marginal ridge is approached, the cut should be made so the distopulpal or mesiopulpal angle is greater than 90° and remains rounded. There should be sound dentin supporting the distal enamel wall below the marginal ridge. An undercut is not required in this area for retention of the restoration, whether it is amalgam or a casting.

The second part of this question relative to the frequency of fractured cusps may be directly related to these cracks, or may be completely unrelated.

Fractured, or split, cusps have been the subject of many articles and presentations by Dr Miles Markley and many other clinicians. Only a summary of their priniciples for preventing fractured cusps can be given in this space.

1. Preserve intact all ridges—transverse, marginal, and others holding the buccal and lingual cusps together—that are supported by sound dentin.

2. When it is necessary to cut across the areas, use a 329 or 330 bur to keep the cut to the size of the smallest condenser which will compact the amalgam.

Also, before cutting, mark the centric stops and working and balancing glides with thin articulating paper, for example Accu II. Cover these marks with Copalite to prevent their washing away during the operative procedures. Use these marks as guides to load-bearing areas in developing the outline form. If the cut is greater than one quarter the intercuspal distance and the working glide is involved, consider placing a pin or extending the prepa-

ration to protect the cusps with an amalgam or onlay.

The tooth is flexible and if the connecting ridges (tie-rods) have been cut, there will be movement independently in the cusps when the tooth is in function. This movement can also open the margins to permit microleakage for years before the cusp fractures.

Any cracks in the enamel, whether from normal anatomic defects or crazing caused by high-speed cutting, will facilitate the ultimate fracture.

Occlusal Restoration with Amalgam

Dear Woody:

I have just received my summer 1979 issue of *Operative Dentistry* and wish to join the discussion concerning the restoration of occlusion when using amalgam.

I would offer my full support to Will Eames who has once again shown that he is a man of great erudition—truly a dentist's dentist. It seems to me there is no way of reliably restoring occlusion in the classical sense when using a plastic material packed and carved in the oral cavity under rubber dam without being able to relate it to the opposing arch. I agree with Captain McCoy that the anatomy of the opposing teeth should be taken into account but beyond that I find his discussion hard to follow. He tells us how to detect contacts accurately but he does not explain how to add additional amalgam to compensate for the deficiencies that we have already introduced. Neither does he explain how, having adjusted the occlusion to perfection, we can then polish that amalgam without taking it out of contact.

The answer of course is that amalgam cannot be relied upon to restore or maintain posterior occlusion—neither can gold foil. There is only one material which is anything like reliable and then only in skilled hands. That material of course is gold manufactured by an indirect technique.

If I may I would also like to comment upon Dr Ogman's query. I nearly gave up using loupes some years ago because I became so distressed seeing the marginal ridge crack as I entered the fossa in an otherwise virgin area. However, having followed these for a good many years I am convinced that no harm follows—so I've gone back to using loupes.

His final sentence I find a little confusing but I think he is just saying that he sees many fractured cusps in both his own patients and other people's. I find an average of a little over three cusps per adult patient in my practice and hence have a flourishing crown and bridge practice. The phenomenon is at least in part the result of ultra high-speed dentistry and the modern lack of respect for natural tooth structure. There have been a number of articles on the subject lately including one in the *Australian Dental Journal,* February 1978.

Graham J Mount, BDS
188 North Terrace
Adelaide, Australia

Letters

Basic Fuchsin Discloses Carious Dentin

Dear Dr Fusayama:

I have noted your article on the use of basic fuchsin to detect carious dentine (*Operative Dentistry,* 1979, **4,** 63–70). In 1963 I published an article, "El diagnostico clinico de la dentina cariada. Metodo de la fucsina basica" (*Odontologia Uruguaya,* 1963, **18,** 8–11), in which I described the use of basic fuchsin to diagnose carious dentin. This was the first article published on this topic but, unfortunately, my article is not mentioned in your bibliography although you use the same stain with the same purpose.

I began to use the solution of basic fuchsin in 1950. The 0.5% solution of basic fuchsin is effective but clinical and histological findings have shown that solutions of 0.2% or 0.25% are strong enough to diagnose the carious tissue to be removed.

Julio Cesar Turell, DDS, MSD, FACD
Professor and Director
Dental Operatory
Faculty of Dentistry
Soriana 1105, Montevideo, Uruguay

Dear Dr Turell:

Thank you for your kind remarks. I am sorry for not referring to your article, but this happened simply because I did not read your journal published in Spanish.

In checking your article, however, I notice that you used an alcoholic solution of fuchsin. I

don't think it is effective in diagnosing caries. I myself have tried various fuchsin solutions in water, alcohol and other solvents since fuchsin was a very common dye widely used for many years in histological laboratories. When the fuchsin in those solvents was used, even the inner carious dentin or normal dentin was stained by higher concentrations or longer application, and staining was not remarkable by lower concentrations. The boundary of staining was not clear and consistent. I succeeded in differentiating the two layers of carious dentin only by using propylene glycol as the solvent. The most important factor is the use of propylene glycol. We are now using a solution of 1% acid red in propylene glycol, replacing fuchsin by acid red, which is not suspected of being carcinogenic.

Please understand also that there are two layers of carious dentin, which are not really healthy, that is, the outer carious dentin to be removed and the inner carious dentin to be preserved. They are clearly differentiated only with a propylene glycol solution of various dyes. Among many dyes tested, fuchsin and acid red were found most effective.

I thank you for your communication, which has given me a chance to further clarify my idea.

Takao Fusayama, DDS, DMSc
Tokyo Medical and Dental University
Department of Operative Dentistry
Yushima, 1-Chome, Bunkyo-Ku
Tokyo 113, Japan

British National Health Service in Dentistry

Dear Sir:

Allan G Osborn's polemic about Britain's dental services dwells too much on events too long ago. I think it may be helpful to your readers if I bring the story up-to-date in three respects. [See Osborn, Spring 1979, pp. 78–80.]

First, dental health: we now have evidence, from national surveys carried out in 1968 and 1978, that tooth loss in the UK is falling dramatically. Among younger adults, edentulousness is at a very low level (3% for 25–34s, compared with 7% in 1968 for the same age group) and we are confident that the downward trend will continue. Treatment patterns also illustrate the changes which are taking place. Crowns, periodontal treatment, and orthodontics are major growth areas, but a substantial proportion of cases now require no treatment at all. More people are receiving treatment, but average treatment needs are declining—throughout the community. Judgments about treatment standards should be based on objective epidemiological evidence of this quality, not subjective impressions.

Second, the profession's feelings: no one forces a dentist to work for the NHS—at all, let alone entirely—so the fact that most private practitioners do, and earn about 90% of their income from it, speaks for itself. Controls on practitioners are few—none at all on things like practice location, for example. Regulations for prior approval of treatment only affect about 5% of cases and are being further relaxed next year.

Finally, professional incomes: Mr Osborn makes no mention of the machinery for reviewing medical and dental pay, which was set up in the early sixties and which proved to be a turning point of major significance. Pay levels are determined by an independent nongovernmental review body and are based essentially on comparisons with professional pay levels outside the NHS. It is true that political events have sometimes prevented the system from working as smoothly as we would like. But ground lost is subsequently regained and 1978 and 1979 have seen large increases in dental fees as part of a staged "catching up" process.

I am not suggesting that our system is perfect, or that we have all the answers. But I hope that your readers will judge the NHS dental services as they now exist, rather than condemning them in the light of events twenty to thirty years ago.

R B Allen
Secretary
British Dental Association

Voices for Operative Dentistry

Dear Sir:

I am writing to express my views on the Point of View, "Dental Education: Where Are the Voices for Operative Dentistry?" (**4**, 132–133) by Chester J Gibson.

My interpretation of this point of view is that there is a cry and a call. I sympathize with the writer's lament that the quality of operative dental education has declined dramatically. I understand the writer's call to action to rectify this problem. I, however, totally disagree that

the call should be predicated upon the definition that dentistry is the art and science of restoring the mouth and its related structures to a normal state of health and then maintaining that state of health. This narrow definition of dentistry does not take into consideration that the patient is human and that dentistry is more than a technical skill. Such narrow terms have been a great disservice to the public and the profession of dentistry. I urge readers of *Operative Dentistry* to appreciate the cry, but before acting upon the call, assume a wider focus for the sake of the patient and the profession.

Lawrence F Jones, DDS
50 Cork Street, E
Guelph, Ontario
Canada N1H 2W8

Author's comment: It is possible that Dr Jones missed the whole point I was attempting to make. We are all aware, I am sure, that our patients are human and must be cared for with holistic understanding. However, the core of dentistry is the oral structures. If it were not so our profession would be called by another name.

Although dentistry can rightly take many ramifications, let us not forget that the central focus of our profession is the care of the mouth. This is the basis of our educational training. After a firm, knowledgeable foundation is established in this area, the avenues for advancement are limitless.

Chester J Gibson, DMD
345 E Sixth St
McMinnville, OR 97128

Research and Teachers of Operative Dentistry

Dear Sir:

I read your editorial in the Autumn 1979 issue of *Operative Dentistry* (Vol 4, No 4) and find it refreshing to know that someone of your stature understands the plight of the teacher in operative dentistry in the pursuit of research. I might add just a few thoughts of my own. The instructor in operative dentistry has a wide variety of responsibilities. Besides our primary area of concern—preclinical and clinical teaching—many of us support other departments or sections such as dental anatomy and dental materials, and in those schools where extramural or intramural practice programs are in vogue, we do our part also, leaving us little time to engage in productive research applicable strictly to operative dentistry.

It is sad to hear that in many instances the "good clinician" is lost to teaching. Fortunately, here at West Virginia University School of Dentistry such is not the case. I believe that a teacher in operative dentistry can engage in small research projects that are of particular interest to him without losing touch with the reality of his primary objective or purpose. If such small projects were to be pointed toward the enrichment of the individual and of benefit to his teaching responsibilities, whether published or not, I feel we would be taking a step in the right direction. Presently, this is the way it is being handled here at school with the full support of the administration. Consequently, our "good clinicians" are not lost or discouraged. In addition, the Academy would do well to encourage this activity, and taking it one step further, collaboration of the faculty members of the various dental schools whose interests lie in the same area would help.

In any case, your solution is certainly worthy of consideration, but in the meantime, little is better than nothing.

Calvin J. Gaver, DDS
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Book Review

HISTOLOGY OF THE HUMAN TOOTH

Edited by I A Mjör and O Fejerskov

Published by Scandinavian University Books, Munksgaard, Copenhagen, 1979. Second edition. Illustrated and indexed. DK 150 ($30.00).

This second edition of a book on the histology of the human tooth succeeds the first Danish edition published in 1956. After 23 years there is much new information to report. This thin volume of 174 pages, well bound with a hard cover, contains an up-to-date description of the structure and development of not only the human tooth but also the periodontium and includes as well an account of the eruption of teeth.

Although eight authors have contributed to the text the multiple authorship is not apparent to the reader, the prose being clear, concise, and a pleasure to read. The few typographical errors are easily overlooked. References to important articles in the literature are listed at the end of each chapter. The book is illustrated profusely with excellent photomicrographs whose standard of reproduction is high and enhanced by the use of glossy paper of good quality. Where necessary the photographs are supplemented with good line drawings. A major annoyance with some of the photographs is the difficulty of seeing the letters and arrows that are used to indicate specific features. This is because there is not enough contrast between the letters and the background. An illustration of the blood vascular system of the pulp might have been a useful addition as would a discussion of the transalveolar fibers reported by S A Cohn.

As this book is limited to the histology of the teeth and periodontium it is not by itself adequate for a course in oral histology, but nevertheless is a fine complement to a more general text. Graduate and postgraduate students will find a wealth of information and explanation of the structure of some of the most important elements of the masticatory system. Practicing dentists, especially those that studied histology before the advent of the electron microscope, will find in this book an excellent means of renewing and augmenting their knowledge of the structure of the tooth.

A IAN HAMILTON

Press Digest

Bacteria beneath composite restorations—a culturing and histobacteriological study. Mejàre, B, Mejàre, I, & Edwardsson, S (1979) *Acta Odontologica Scandinavica* (37) 267–275.

When 14 class 5 cavities were filled with Adaptic by placing the material in cavities either washed with water and dried with air or washed with an antimicrobial cleaner (Tubulicid) and lined with Tubulitec, bacteria were found after 4-6 weeks on the axial walls of six of the seven unlined cavities and on none of the lined cavities.

Announcements

NOTICE OF MEETINGS

American Academy of Gold Foil Operators
Annual Meeting: October 9 and 10, 1980
Louisiana State University
New Orleans, Louisiana

Academy of Operative Dentistry
Annual Meeting: February 12 and 13, 1981
Hyatt Regency Hotel
Chicago, Illinois

NEWS OF STUDY CLUBS

Course in Gold Foil Procedures

The Associated Ferrier Study Clubs are planning to offer a two-week course in the summer of 1980. This is the class participation, clinical course that is provided by the Association for its associate members. A limited number of nonmembers of the study clubs can usually be accepted into the class, depending on available facilities.

Anyone who is seriously interested in such a course is invited to indicate his or her interest, as soon as possible, to the Association secretary: Dr Donald B Deans, 3819 NE 45th, #D Seattle, WA 98105.

Associated Ferrier Study Clubs

The golden anniversary of the Associated Ferrier Study Clubs will be observed at the annual meeting on May 9, 1980, in Seattle. Members will honor both the memory of Dr Walden I Ferrier, founding director, and members of the original study club—the Seattle Dental Study Club. More than the usual number of operations will be performed.

The active members of the Association, now totaling slightly more than 100, constitute the 13 component clubs in Washington, British Columbia, Alberta, and Manitoba. The individual clubs hold monthly clinical sessions throughout the year. Three of them were functioning in 1930; the newest club was formed in 1977. This year's president of the Association is Dr Harold Sondheim, the secretary-treasurer is Dr Donald Deans, and the program chairman and president-elect is Dr Richard H Johnson, all of Seattle.

G D STIBBS

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, Washington 98195, U.S.A.

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,* 4th ed., 1977; the terms 'canine', 'premolar', and 'facial' are preferred but 'cuspid', 'bicuspid', and 'labial' and 'buccal' are acceptable. SI (Systeme 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 figure size 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 figure number. Type legends on a separate sheet. Where relevant, state staining techniques and the magnification of prints. Obtain written consent from copyright holders to republish any illustrations published elsewhere.

References

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OPERATIVE DENTISTRY

WINTER 1980 • VOLUME 5 • NUMBER 1 • 1–40

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