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

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EDITORIAL

ADA Policy on National Health Insurance: Is It Consistent?

The American Dental Association is generally committed to maintaining private practice as the mode of providing dental service for the American people. Ordinarily the Association voices objection to government schemes for introducing socialized dentistry, but one has the uneasy feeling that someday we shall be told that socialized dentistry—or national health insurance as it is euphemistically called —is an idea whose time has come and that we had better participate so that we may have some control over the direction the system takes. This is like telling the man on the scaffold to put the rope around his neck because the rope will keep his feet from hitting the ground and thus prevent breaking his legs.

A suspicion we are being led the wrong way arises when we note the Association's reaction to plans for national health insurance that contain no provision for dental treatment. Rather than rejoicing at the government's unexpected sagacity, the American Dental Association takes umbrage at what it considers to be a slight to dentistry, on the premise that oral health is an integral part of total health and should be included in any health scheme that is truly comprehensive. It happened with Medicaid. If socialized dentistry would provide better treatment, the action of the American Dental Association could be applauded—but such is not so.

Dentistry in the United States is not without faults but it provides a service comparable to the world's best and much better than that provided in most countries. The best way to improve our service is to improve the quality of restorative dentistry. Such an improvement, however, would not occur under national health insurance. On the contrary, quality would decline. And how unfortunate for the patients!

Rather than waste its resources in trying to ensure a place for dentistry in national health insurance, the American Dental Association could benefit patients by doing all it can to improve the quality of restorative dentistry. Among other measures the Association could help substantially by according a place among the specialties of dentistry to operative dentistry (the only major branch of dentistry without specialty status) and so encourage young graduates to embrace operative dentistry as a career, and by more comprehensive testing and monitoring of dental products. If the government neglects to include dentistry in a national health plan, so much the better. Be thankful.

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ORIGINAL ARTICLES

Burnished Amalgam Restorations: A Two-Year Clinical Evaluation

Burnished amalgam restorations can have as much marginal integrity as polished restorations but it depends on the alloy used or the time at which the amalgam is burnished.

KARL F LEINFELDER • WILLIAM D STRICKLAND
JOE T WALL • DUANE F TAYLOR

Summary

The effect of burnishing and polishing on the marginal integrity of Velvaloy and Pacs was monitored in 360 restorations over a period of two years. The comparative performance of the alloys and finishing techniques was determined by photographic ranking. For Velvaloy, burnishing after carving produced restorations whose marginal integrity equaled that of polished restorations. Burnishing of Pacs, however, produced restorations that developed marginal ditching. Restorations that were neither polished nor burnished were more susceptible to deterioration.

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INTRODUCTION

For more than 30 years dentists believed that rubbing the surface of a newly carved amalgam resulted in a surface that was rich in mercury, particularly at the margins (Sweeney, 1944; Phillips, 1953; Blackwell, 1955). Hence, it was concluded that burnished restorations would be more susceptible to corrosion and show a higher rate of marginal fracture. Recently, however, Charbeneau (1965) has suggested that burnishing after carving is not detrimental to the longevity of amalgam restorations because the hardness of polished surfaces and burnished surfaces is similar. This view is supported by a study showing that burnishing reduces both residual mercury and porosity (Kanai, 1966). Furthermore, after measuring the rate of corrosion of burnished amalgams, Svare & Chan (1972) have suggested that amalgam restorations might be improved by burnishing rather than by polishing or by leaving the surface unfinished. In fact, it has been suggested that burnishing may be a viable substitute for polishing. However, these hypotheses have been neither confirmed nor refuted by any clinical studies. The purpose of this study was to evaluate, over a period of two years, the marginal integrity of amalgam restorations that had been burnished immediately after carving and to compare the results with

amalgams that had been carved only, carved and polished, or carved, burnished, and polished.

MATERIALS

The alloys selected for this study are Velvaloy (S S White, Philadelphia, PA 19102, USA) and Pacs (Lactona Corp, Morris Plains, NJ 07950, USA). They are lathe-cut alloys of conventional composition that differ in size of particles as well as in working or carving time. The particles of the two alloys are shown in scanning electron micrographs (Fig 1). Although the mean size of the particles of both alloys is similar, Pacs has a greater range of sizes. The carving time of Velvaloy is six minutes, that of Pacs nine minutes or longer.

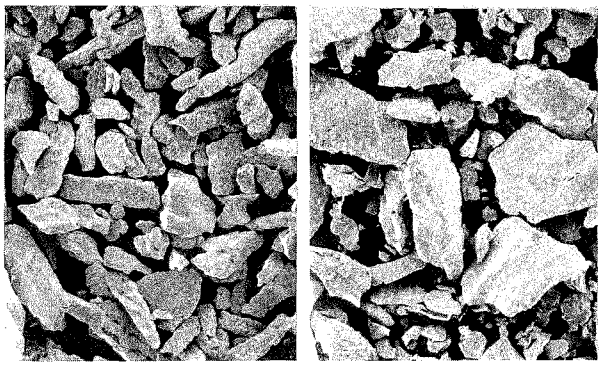

FIG. 1. Scanning electron micrograph of the particles of Velvaloy (left) and Pacs (right)

METHODS

Approximately 45 restorations of each combination of variables for a total of 360 restorations were inserted into class 1, 2, 3, and 5 cavities over a period of 12 months by three clinicians. Alloys and finishing techniques were assigned to particular teeth by random sampling, which resulted in nearly equal numbers of restorations in each category. Distribution of samples according to finishing technique is shown in Table 1.

All teeth were prepared and restored under a rubber dam. An effort was made to include only those teeth requiring cavity preparations of a standard size involving one, two, or three surfaces. Teeth requiring pins or capping of cusps were not included. Premeasured disposable capsules were used and all amalgams were triturated for 20 seconds in an amalgamator at medium speed. The ratio of mercury to alloy for Velvaloy was 1.1:1; that for Pacs was 1:1. The accuracy of the ratios was checked intermittently. No attempt was made to express excess mercury before condensation.

Table 1. Distribution of Samples

Finishing Technique	Velvaloy	Pacs
Carving only	45	45
Polishing (*control*)	40	40
Burnishing	48	52
Burnishing & Polishing	47	43

Techniques for Finishing Amalgam Restorations

- *Carving only*—After the amalgam was condensed, the surface was carved to proper contour and occlusion with a discoid, cleoid, or Hollenback carver. There was no further treatment.
- *Polishing* (Control samples)—Twenty-four hours to two weeks after the restoration was inserted and carved, the surface was finished with a mounted green stone or a white stone of fused alumina. The surface was then smoothed with a series of finishing burs and polished first with flour of pumice in a rubber cup and finally with powdered chalk.
- *Burnishing*—Immediately after being carved, the surface was lightly burnished or rubbed with a ball burnisher approximately 1.5 mm in diameter. The instrument was moved across the amalgam surface in a rapid oscillating motion with light pressure—only enough to produce a satin or velveteen finish rather than a highly reflective surface. There was no further treatment.
- *Burnishing and Polishing*—Twenty-four hours to two weeks after insertion, carving, and burnishing, the surface was polished as for the control samples.

Assessing Performance

Black and white photographs of each restoration at a magnification of 1.5 were taken at the time of insertion or after the restoration had been burnished or polished. Photographs were again taken of each restoration after one and two years. Each print was enlarged so that

Table 2. Ranking of Alloys and Finishing Techniques According to Marginal Integrity of Restorations at One Year

Rank	Finishing Technique	Alloy	Rank (Mean)
1	Polishing *(control)*	Velvaloy	2.03
2	Burnishing & Polishing	Velvaloy	2.53
3	Polishing *(control)*	Pacs	2.87
4	Burnishing	Velvaloy	3.20
5	Carving only	Pacs	3.40
6	Burnishing & Polishing	Pacs	3.53
7	Carving only	Velvaloy	4.20
8	Burnishing	Pacs	4.26

the diameter of the tooth was increased seven times. The photographs were used to evaluate marginal integrity.

The photographs of all restorations of the same age were ranked according to clinical performance. The restoration showing the least marginal failure was ranked as number one and that with the greatest ranked number 360. The rank numbers for each condition were averaged and the mean values arranged from the lowest to the highest to provide a numerical ranking for each condition. The photographs were ranked by three evaluators using a technique essentially the same as one of the methods described by Osborne *& others* (1976).

A Kruskal-Wallis analysis of variance test was used to determine the statistical significance of differences in marginal deterioration among the various combinations of alloy and finishing technique. Spearman's rank correlation test was used to determine interexaminer consensus.

Scanning electron micrographs were used to evaluate the extent of marginal breakdown. Silicone replicas of Xantopren Blue (Unitek Corp, Monrovia, CA 91016, USA) were made of selected amalgam restorations after various periods of clinical service. The replicas were then mounted in die stone and cast with Ortho Bond epoxy resin (Vernon-Benshoff Company, Inc, Albany, NY 12207, USA). These positive replicas were coated first with carbon and then with gold-palladium (60:40) to prepare them for observation.

RESULTS

The data derived from ranking the clinical photographs of the various finishing techniques at the end of the first year can be seen in Table 2. The data represent the mean value of rankings by three evaluators for ditching or marginal deterioration.

The lower the mean value the better the clinical performance. The lowest possible score is 1.0 and the highest 7.0. These scores, however, could occur only if all specimens of one alloy

Table 3. Ranking of Alloys and Finishing Techniques According to Marginal Integrity of Restorations at Two Years

Rank	Finishing Technique	Alloy	Rank (Mean)
1	Polishing	Pacs	2.09
2	Burnishing	Velvaloy	2.68
3	Burnishing & Polishing	Velvaloy	3.81
4	Polishing	Velvaloy	3.87
5	Carving only	Pacs	4.34
6	Burnishing & Polishing	Pacs	4.65
7	Carving only	Velvaloy	5.37
8	Burnishing	Pacs	5.60

ranked above or below all others. At the end of the first year, six combinations of alloy and finishing technique are statistically indistinguishable; the remaining two form a separate group. The first group contains the two control conditions and is significantly better than the second group ($P = 0.01$). At the end of the second year the number of combinations remaining in the first group had decreased to four—the two controls and burnished Velvaloy, polished and unpolished (Table 3). The effect of burnishing on marginal integrity clearly depends upon the alloy used. For Velvaloy no difference in marginal integrity could be detected between those samples that had been polished and those that had been burnished.

The effect of polishing amalgam restorations on marginal integrity is also illustrated in Table 3. Regardless of the alloy used, restorations that had been carved and then polished at another appointment show a lower rate of marginal failure than those that had received no further treatment.

The effect of burnishing on the marginal integrity of the alloys included in this study is shown in Figure 2. Figures 2a and 2b show four restorations at the time of their final treatment. Figure 2a shows two Velvaloy restorations. Figure 2b shows two burnished restorations—Velvaloy in the molar and Pacs in the premolar. The marginal integrity of the two Velvaloy restorations (Fig 2c) is similar after two years. The two restorations in Figure 2d, however, differ appreciably in marginal integrity. The burnished Velvaloy restoration (first molar) shows little ditching but the marginal deterioration of the burnished Pacs restoration (second premolar) is substantial.

Scanning electron micrographs (Fig 3) show the occlusal surface of the two restorations in Figure 2d viewed from the direction of the proximolingual angle. It is easy to compare the

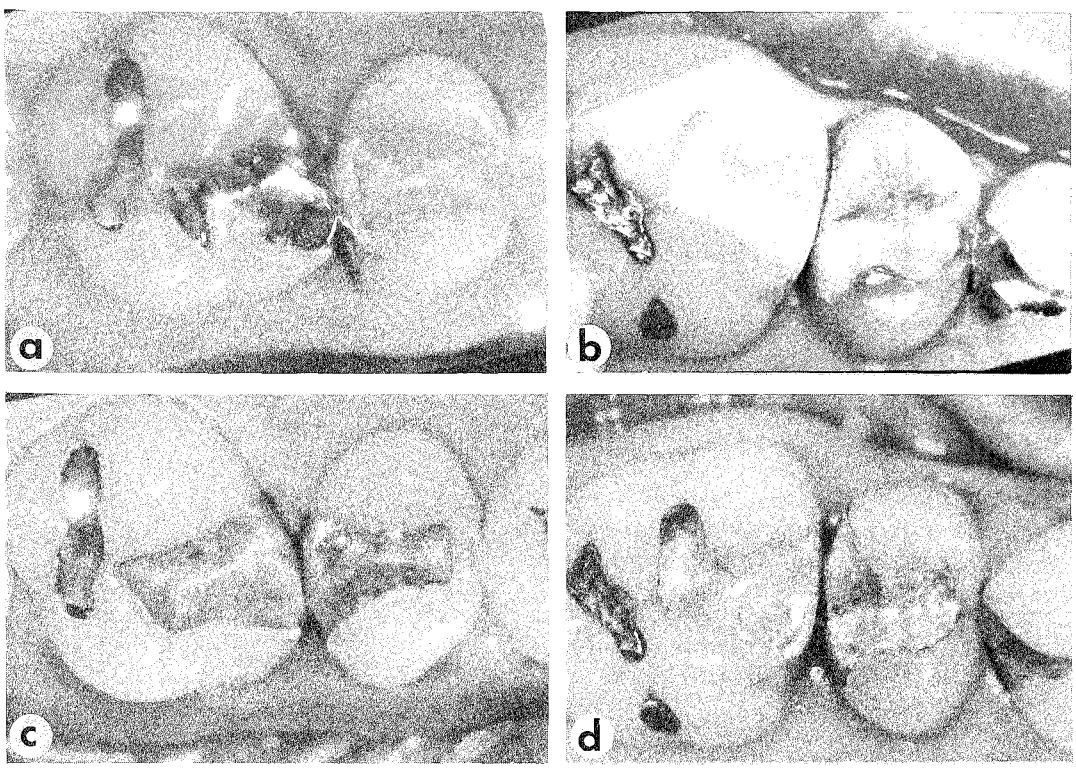

FIG. 2. Photographs of selected restorations at the time of insertion and after two years of service. Both the molar and second premolar in 2a are restored with Velvaloy. The mesio-occlusal restoration in the first molar was polished; the disto-occlusal restoration in the premolar was burnished. The first molar illustrated in 2b is restored with Velvaloy; the second premolar is restored with Pacs. Both restorations were burnished immediately after carving. 2c and 2d are photographs of the same teeth as shown in 2a and 2b after two years of service.

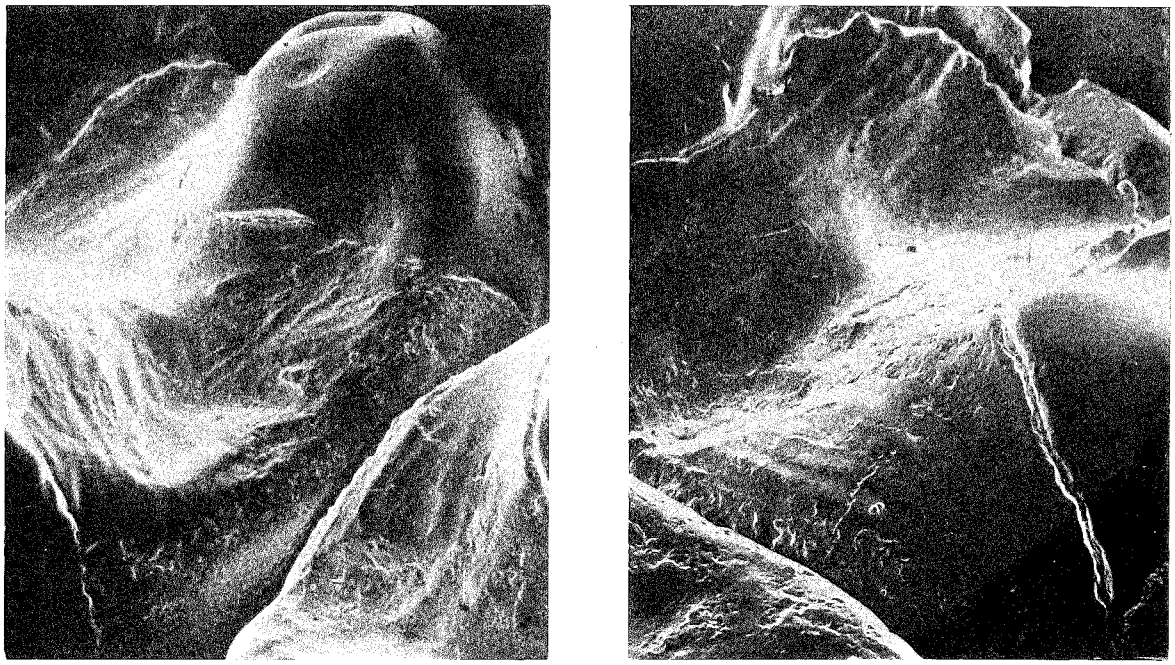

FIG. 3. Scanning electron micrograph of the restorations illustrated in Figure 2d. The occlusal surface of both teeth are viewed from the direction of the proximolingual line angle. (Original magnification 10 X)

marginal failure of the two alloys. The extent of ditching in the Pacs restoration (right) is generally uniform and continuous along the entire margin. In centric holding areas where a cusp to fossa relationship exists the ditching is accentuated, for example, the area of the mesial pit on the second premolar.

A higher magnification of the interface of burnished Velvaloy and tooth is illustrated in Figure 4. The area demonstrated is the facial portion of the mesial marginal ridge. Good continuity can be seen between the amalgam and tooth structure. The excessive ditching in the upper part of the illustration is in the area of the transverse ridge and is not representative of the rest of the margins. The ridges or ripples on the surface of the amalgam are indentations left by the ball burnisher.

A margin of one of the restorations of burnished Pacs can be seen in Figure 5. The area shown is along the distofacial angle just below the occlusal surface. The extent of marginal deterioration can be demonstrated by the depth of exposed walls of the original cavity as well as by the width of the trough. Although the amount of ditching is extensive there is good adaptation of the amalgam to the wall of the cavity.

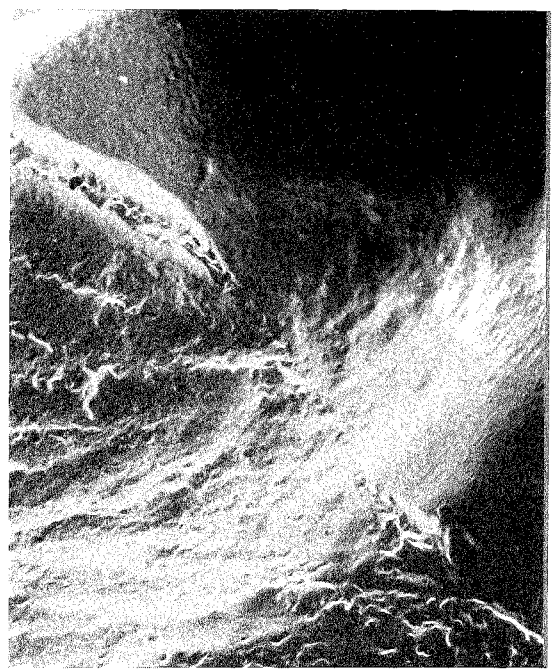

FIG. 4. Higher magnification of the interface of Velvaloy and tooth shown in Figure 3. Note the continuity between the enamel and the amalgam restoration. The ditching seen in the upper right portion of the illustration is in the area of the transverse ridge and is not representative of the rest of the margins. (Original magnification 25 X)

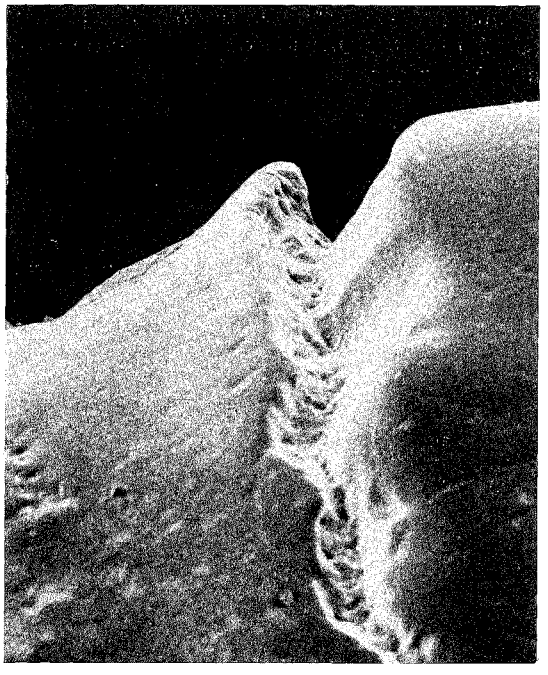

FIG. 5. Scanning electron micrograph of a margin of a Pacs restoration. The area illustrated is along the distofacial line angle below the occlusal surface. Note the exposed walls of the original cavity. (Original magnification 75 X)

DISCUSSION

This study has shown that the effectiveness of burnishing after carving depends on the alloy used. The effect of burnishing on marginal integrity appears to be related to the distribution of particle size and the carving time of the alloys. The working or carving time of Velvaloy is about six minutes whereas that of Pacs is at least nine minutes—50% longer. Perhaps the light rubbing with the burnisher on the surface of Pacs produced a layer rich in mercury due to the relatively slow rate of setting. Possibly the deleterious effect of burnishing on this slower setting alloy could have been avoided if the time of burnishing had been delayed three to five minutes or until setting had progressed to a later stage.

The relationship between the properties of the amalgams and the faster rate of marginal deterioration could be explained as follows: during light burnishing the larger particles might settle below the surface in the same way that gravel in a wet mix of concrete settles during troweling or surfacing. As the larger particles of alloy settle below the surface during burnishing, a layer rich in mercury develops, resulting in lowered resistance to corrosion. A relatively slow rate of set could compound or exaggerate the problem by making it easier to depress the large particles. A large range of sizes is needed for the effect to occur at all.

The results of this study show the same general trends reported by Svare & Chan (1972). Both studies reveal that burnishing Velvaloy does not produce undesirable results. Whereas their laboratory study demonstrated that the resistance of amalgam surfaces to corrosion was appreciably improved by burnishing, our study shows that the marginal integrity of polished surfaces and burnished surfaces are equal. Furthermore, both studies have demonstrated that those amalgam restorations that are neither polished nor burnished are the most susceptible to deterioration.

Amalgam may be burnished either before or after carving. Most of the studies reported in the literature involve burnishing after carving. Burnishing before carving, which is essentially an extension of normal condensing procedure, has been advocated recently by several clinicians. The technique, which consists of overfilling and then burnishing heavily, supposedly reduces porosity as well as content of mercury (Kanai, 1966; Jørgensen & Saito, 1967). Initial results from a clinical study of ours have revealed that amalgams of conventional composition that are burnished before carving undergo marginal failure at a slower rate than those not subjected to this treatment.

Probably the initial concerns expressed by Phillips (1953) and Sweeney (1944) about the potentially harmful effects of burnishing on amalgam were not unfounded. The time available in those days for carving most amalgams was 10 to 15 minutes because most of the earlier alloys consisted of particles that were appreciably larger than those available today.

Further research of this type is needed before definitive statements can be made as to the precise effects of burnishing versus nonburnishing. Longer term observations also are needed.

When we began this study only one of the alloys with a high content of copper was available commercially. One-year results from an ongoing study of ours, however, suggest that

burnishing after carving is recommended for copper additive alloys as well as for the newer ternary alloys with a high content of copper.

CONCLUSIONS

1. The effect of marginal integrity of burnishing after carving depends on the alloy used or the time at which the amalgams are burnished.

2. No significant difference in the clinical performance of Velvaloy and Pacs could be detected after two years when finished conventionally and subsequently polished.

3. Regardless of the alloy used, those restorations that received no treatment beyond carving exhibited a rate of marginal failure significantly higher than those that were polished, or burnished, or both burnished and polished.

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References

BLACKWELL, R E (1955) *Black's Operative Dentistry.* 9th edition, vol 2, p 288. South Milwaukee, WI: Medico-Dental Publishing Co.

CHARBENEAU, G T (1965) A suggested technic for polishing amalgam restorations. *Journal of the Michigan Dental Association*, **47**, 320–325.

JØRGENSEN, K D & SAITO, T (1967) Structure studies of amalgam V: the marginal structure of occlusal amalgam fillings. *Acta Odontologica Scandinavica*, **25**, 233–245.

KANAI, S (1966) Structure studies of amalgam II: effect of burnishing on the margins of occlusal amalgam fillings. *Acta Odontologica Scandinavica*, **24**, 47–53.

OSBORNE, J W, PHILLIPS, R W, GALE, E N & BINON, P P (1976) Three-year clinical comparison of three amalgam alloy types emphasizing an appraisal of the evaluation methods used. *Journal of the American Dental Association*, **93**, 784–789.

PHILLIPS, R W (1953) Amalgam—its properties and manipulation. *New York Journal of Dentistry*, **23**, 105–109.

SVARE, C W & CHAN, K C (1972) Effect of surface treatment on the corrodibility of dental amalgam. *Journal of Dental Research*, **51**, 44–47.

SWEENEY, J T (1944) Manipulation of amalgam to prevent excessive distortion and corrosion. *Journal of the American Dental Association*, **31**, 375–380.

Biologic Assessment of Restorative Dental Materials: Interrelationship of Biologic and Technologic Properties

The effect of a restorative material on living tissue should be known before the material is used.

IVAR A MJÖR

Summary

Assessment of the biologic response of living tissue to restorative materials is an important test for restorative materials. They may be tested histologically for pulp reactions and also by cell culture techniques and subcutaneous implantation. From such tests Cu amalgam has been shown to be severely irritating, Ag/Sn amalgam almost nonirritating, and Ag/Sn/Cu amalgam only slightly irritating. Biologic tests should be included in the specifications for dental materials.

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Presented March 31, 1977, at Symposium II, "Restorative Dental Materials," International Association for Dental Research, Copenhagen, Denmark

INTRODUCTION

The importance of knowing the effect of a restorative material on living tissue is generally recognized, yet biologic requirements have not been included in the specifications for dental materials. Specifications for dental amalgam were developed about 40 years ago—nearly 400 years after the first written record of the use of amalgam in dentistry (American Dental Association, 1976). Although Specification No 1 of the American Dental Association has been revised several times and though the composition and physical properties of amalgam have been specified, there are no specifications for biologic assessment. This is true for all restorative materials. The purpose of this article is to stress the need for assessing the biologic reaction to restorative materials.

TECHNOLOGIC ASPECTS

A few attempts have been made to correlate physical properties of restorative materials and clinical performance, but reports attempting to correlate laboratory testing and *biologic* properties are indeed scarce. Some physical properties, such as compressive strength, may not be of prime importance for biologic evaluation;

but other properties, such as solubility and dimensional change, are probably of utmost importance.

Solubility, or disintegration, and dimensional change both contribute to microleakage around restorations. A contracting material leaves a space between the tooth and the restoration. Such a space is potentially dangerous because it may allow the ingress of toxins and the growth of bacteria. Similar problems of microleakage arise if the cement holding an inlay or crown dissolves. The problem of microleakage has been evaluated in many ways, but the correlation between microleakage, dimensional change, and biologic effects has been little emphasized. Brännström & Nyborg (1973), for example, have demonstrated growth of bacteria at the interface of composite resin and tooth in unlined cavities and have concluded that the pulp reactions noted were due to bacterial toxins rather than to the bacteria themselves. But the use of composite resin without a liner is not clinically relevant. Furthermore, they used a brand of composite resin that is not bactericidal (Ørstavik & Henstен-Pettersen, 1977). Further studies are required before practical conclusions can be drawn from the studies of Brännström and co-workers on the importance of bacteria at the interface of tooth and filling.

Several brands of amalgam have been compared for leakage by a specially designed technique for measuring the amount of air per unit of time that passes between a test specimen of amalgam and the mold (Granath, 1971). Granath has concluded that a good seal between the filling and the cavity walls depends more on the plasticity of amalgam than on dimensional change. The deposition of corrosion products of amalgam is also important in reducing microleakage.

Certain restorative materials with favorable physical properties have failed because of undesirable biologic qualities. Alloys of gallium-palladium-tin are, in several important properties, superior to conventional dental alloys (Waterstrat, 1969), but implantation studies (Lyon, Waterstrat & Paffenbarger, 1966) and pulp studies (Langeland, Yoshiki & Langeland, 1967) have shown that the alloy produces severe reactions and consequently further development has been discontinued.

The use of cold-curing methyl methacrylate for restorations has also largely been discontinued due to reports of properties that are biologically undesirable (Nygaard-Östby, 1955). The main problems are a toxic reaction to the monomer and marked setting contraction of the material. The setting contraction is compensated by subsequent absorption of water (Asmussen & Jørgensen, 1972) but, despite the hygroscopic expansion, marginal percolation may occur as a result of temperature cycling.

BIOLOGIC ASPECTS

The methods most commonly employed for biologic evaluation of restorative materials are: usage tests, implantation tests, and cell culture tests. Studies on amalgam will be used to exemplify these methods. Data from all of these techniques are available on the old type of Cu amalgam and on conventional Ag/Sn amalgam (Mjör & *others*, 1977). In addition, findings from implantation tests and pulp studies on a non-γ_2 amalgam with a high content of copper will be discussed. This amalgam will be referred to as an Ag/Sn/Cu amalgam.

Usage Tests

The usage test for restorative materials involves the insertion of restorations in class 5 cavities in intact teeth, preferably young human teeth, or in newly erupted monkey teeth, or in teeth from other appropriate animals. A control of the effect of cavity preparation is required, and it is advisable to use materials for a positive and a negative control of the tissue response (American Dental Association, 1976). Conventional Ag/Sn amalgam in such an experimental model will give a slight pulpal reaction, except in cavities that are especially deep (Möller & Granath, 1973). If Cu amalgam is used, moderate or severe reactions are usually found in the teeth after both relatively long and short periods of observation (Mjör & *others*, 1977).

Subcutaneous Implantation

Different responses to these two types of amalgam have also appeared in tests where the two materials have been placed in polyethylene tubes and inserted subcutaneously. Macroscopically no reactions are found to Ag/Sn amalgam (Figs 1 & 2). Histology of the subcuta-

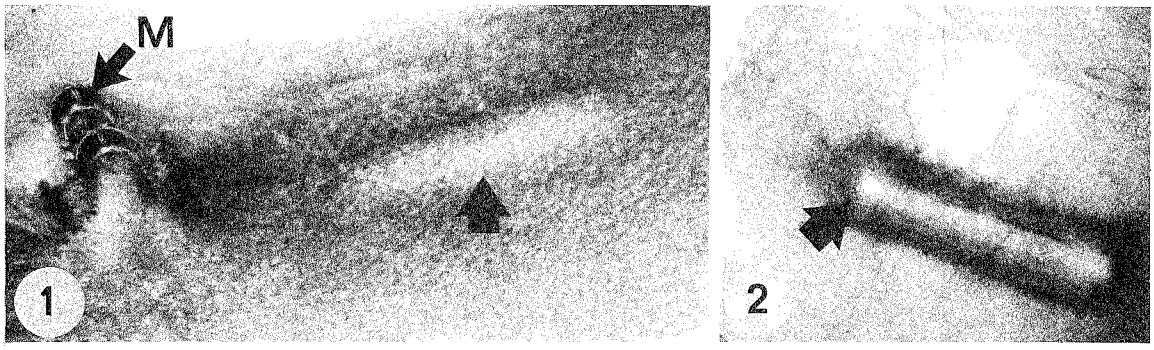


FIG. 1. Subcutaneous implant (arrow) of polyethylene tube containing conventional Ag/Sn amalgam. M, metal suture.
FIG. 2. Same implant (arrow) as seen in Figure 1 after excision of skin

neous tissue from such experiments indicates a slight initial reaction to Ag/Sn amalgam that decreases in time (Mjör & *others*, 1977).

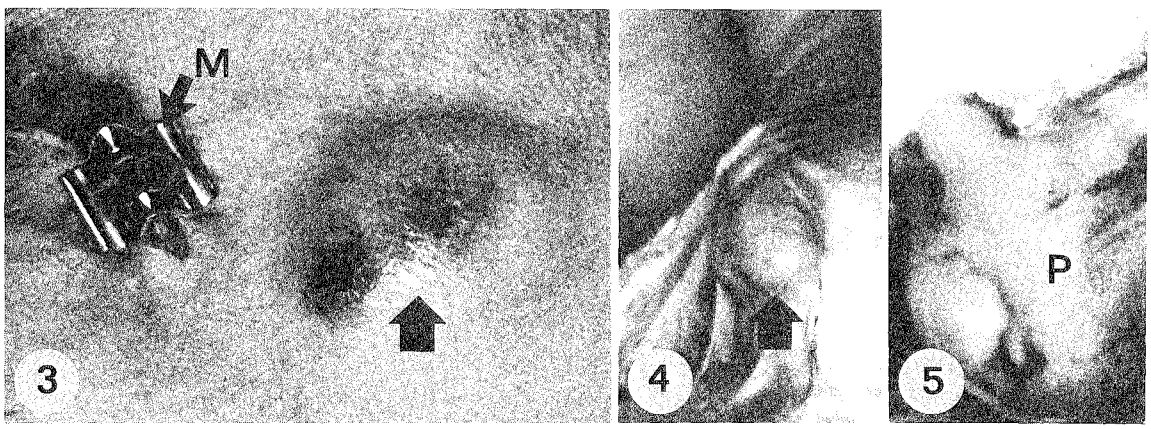
Cu amalgam, on the other hand, produces severe reactions. After seven days a marked swelling can be seen clinically (Figs 3 & 4) and it is apparent that abscesses have formed. If such swellings are excised, pus discharges (Fig 5). Most of the implants of Cu amalgam exfoliated within 10 to 30 days time. The conclusion from these implantation studies, which also include histologic assessment, is that the reaction of the tissue to Cu amalgam is extremely severe (Mjör & *others*, 1977).

Cell Culture Tests

Several techniques of cell culture are available and though the reported results differ, depending on the technique, the overall conclusions for various materials are similar in correlative studies (Hensten-Pettersen & Helgeland, 1977). Studies of set specimens of the same amalgams placed in cell cultures (Leirskar & Helgeland, 1972) have revealed results comparable with those of the pulp reactions and implantation tests already described, that is, slight reaction to Ag/Sn amalgam and marked toxicity to Cu amalgam. If the amalgam had been used immediately after packing and before it had set, some toxicity of Ag/Sn amalgam would also have been found due to the presence of unreacted mercury (Kawahara & *others*, 1975).

The table summarizes the major conclusions using cell culture techniques, implantation tests, and usage tests. A good correlation exists between cell culture tests, subcutaneous implantation tests, and clinical tests but the respective values are not directly comparable.

FIG. 3. Subcutaneous implant of polyethylene tube containing Cu amalgam. Note swelling (arrow). M, metal suture.
FIG. 4. Same implant and swelling (arrow) as seen in Figure 3 after excision of skin
FIG. 5. Swelling shown in Figure 4 after excision. P, pus.



Biologic Tests of Amalgam

Type of Amalgam	Type of Test		
	Cell Culture 24-h specimen	Implantation	Pulp Reaction
Ag/Sn	−	+	+
Cu	+++	+++	++/+++

+ = reaction; more + s, more reaction
− = little, or no, reaction

It must be stressed, however, that this correlation does not apply to other restorative materials evaluated by these same techniques. If data from similar investigations on a composite material, silicate, and zinc oxide and eugenol cement are compared there is poor correlation between the results of the tests (Mjör, Hensten-Pettersen & Skogedal, 1977). For this reason, it is important to emphasize that no laboratory test or simple toxicity test suffices for the routine evaluation of the biologic properties of restorative materials. In fact, from the many biologic screening tests and general toxicity tests available it appears that it is always possible to find one that is negative or positive for a particular material. Presently, therefore, the only valid test is the usage test and for restorative materials that means pulp studies.

Dissolution of Copper from Amalgams

Data from cell culture studies indicate that dissolved copper may be the main cause of the toxicity of Cu amalgam (Leirskar, 1974). Dissolution of copper from various amalgams in artificial saliva has been evaluated (Espevik, 1977). The results of these studies demonstrate that Cu amalgam, which has been shown to be toxic, exhibits by far the greatest release of copper and that practically no copper dissolves out of conventional Ag/Sn amalgam. The new non-γ_2 amalgams containing up to 30% copper show relatively low and variable dissolution of copper. The amount of copper released is not related to the copper content.

Data on Sybraloy (Kerr Manufacturing Co, Romulus, MI 48174, USA), which has a relatively high content of copper, but shows a relatively slight release of copper in artificial saliva (Espevik, 1977), gives results similar to those for conventional Ag/Sn amalgam when implantation techniques are used (Mjör & *others*, 1977). Pulp studies suggest that the results are slightly more marked than those for conventional amalgam in unlined cavities. Figure 6 shows the reaction to Ag/Sn/Cu amalgam 72

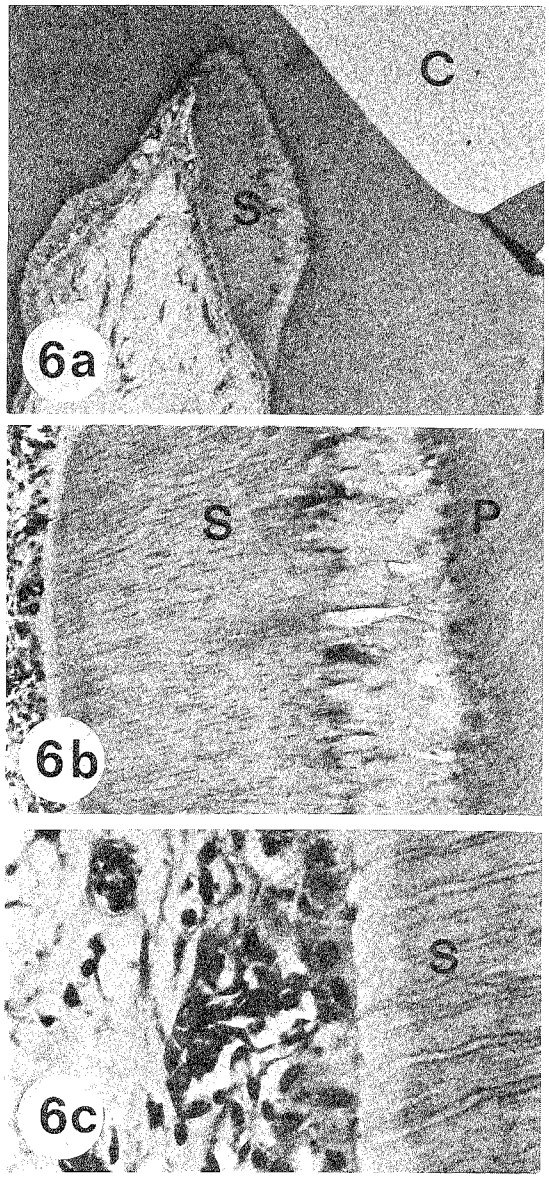


FIG. 6. Cavity (C) has been restored with an Ag/Sn/Cu amalgam 72 days prior to sacrificing the monkey. Note large amount of irregular secondary dentin (S) subjacent to the cavity. The dentin structure is particularly irregular at the junction of primary (P) and secondary (S) dentin. The pulp is slightly inflamed. Hematoxylin and eosin. (a) X 25; (b) X 120; (c) X 450

days after the amalgam had been inserted without a base into a cavity in a monkey tooth. Large amounts of secondary dentin have formed subjacent to the cavity and, close to the primary dentin, the structure of the secondary dentin is particularly irregular. The pulp is slightly inflamed.

The results from the pulp studies on Ag/Sn/Cu amalgams are not dramatic and are only slightly more pronounced than those of conventional Ag/Sn amalgam. The amazing point is that non-γ_2 amalgams were introduced on the market before any studies of their effect on the pulp had been published. With the data available on Cu amalgam and on the toxicity of copper (Dixon & Rickert, 1933; Leirskar, 1974), this is surprising, but quite representative of the state of the art for biologic assessment of restorative materials.

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References

AMERICAN DENTAL ASSOCIATION (1976) *Guide to Dental Materials and Devices*. 8th edition. Pp 58, 200–206. Chicago: American Dental Association.

ASMUSSEN, E & JØRGENSEN, K D (1972) A microscopic investigation of the adaptation of some plastic filling materials to dental cavity walls. *Acta Odontologica Scandinavica*, **30**, 3–21.

BRÄNNSTRÖM, M & NYBORG, H (1973) Cavity treatment with a microbicidal fluoride solution: growth of bacteria and effect on the pulp. *Journal of Prosthetic Dentistry*, **30**, 303–310.

DIXON, C M & RICKERT, U G (1933) Tissue tolerance to foreign materials. *Journal of the American Dental Association*, **20**, 1458–1472.

ESPEVIK, S (1977) The effect of Cu additions on the corrosion of amalgam. *Journal of Dental Research*, **56**, *Special Issue A, Program and Abstracts of Papers*, Abstract No 237, p A102.

GRANATH, L-E (1971) Studies on microleakage with restorative materials. III. *In vitro* experiments on the sealing of 9 brands of silver amalgam. *Acta Odontologica Scandinavica*, **29**, 65–73.

HENSTEN-PETTERSEN, A & HELGELAND, K (1977) Evaluation of biologic effects of dental materials using four different cell culture techniques. *Scandinavian Journal of Dental Research*, **85**, 291–296.

KAWAHARA, H, NAKAMURA, M, YAMAGAMI, A & NAKANISHI, T (1975) Cellular responses to dental amalgam in vitro. *Journal of Dental Research*, **54**, 394–401.

LANGELAND, L K, YOSHIKI, S & LANGELAND, K (1967) Biologic evaluation of a gallium alloy. *International Association for Dental Research, Program and Abstracts of Papers*, Abstract No 24, p 42.

LEIRSKAR, J (1974) On the mechanism of cytotoxicity of silver and copper amalgams in a cell culture system. *Scandinavian Journal of Dental Research*, **82**, 74–81.

LEIRSKAR, J & HELGELAND, K (1972) A methodologic study of the effect of dental materials on growth and adhesion of animal cells in vitro. *Scandinavian Journal of Dental Research*, **80**, 120–133.

LYON, H W, WATERSTRAT, R M & PAFFENBARGER, G C (1966) Soft tissue response to implants of gallium alloys and silver amalgam alloys. *Journal of the American Dental Association*, **72**, 659–664.

MJÖR, I A, ERIKSEN, H M, HAUGEN, E & SKOGEDAL, O (1977) Biologic assessment of Cu-containing amalgams. *International Dental Journal*, **27**, 333–340.

MJÖR, I A, HENSTEN-PETTERSEN, A & SKOGEDAL, O (1977) Biologic evaluation of filling materials. A comparison of results using cell culture techniques, implantation tests and pulp studies. *International Dental Journal*, **27**, 124–129.

MÖLLER, B & GRANATH, L-E (1973) Reaction of the human dental pulp to silver amalgam restorations. *Acta Odontologica Scandinavica*, **31**, 187–192.

NYGAARD-ÖSTBY, B (1955) Pulp reactions to direct filling resins. *Journal of the American Dental Association*, **50**, 7–13.

ØRSTAVIK, D & HENSTEN-PETTERSEN, A (in press) Antibacterial activity of tooth-colored dental restorative materials. *Journal of Dental Research*.

WATERSTRAT, R M (1969) Evaluation of a gallium-palladium-tin alloy for restorative dentistry. *Journal of the American Dental Association*, **78**, 536–541.

DENTAL PRACTICE

The Axial Wall Revisited

The ideal location and depth of the axial wall should be kept in mind when retentive features and bases are being placed in a cavity.

WALLACE W JOHNSON • LUIZ C TEIXEIRA

Summary

The preparation of a cavity in a tooth should serve three basic and equally important functions. These are: (1) the removal of an invading carious lesion; (2) the removal of additional tooth structure in a prescribed manner, so that a restoration can be placed that has both the proper kind of support from the tooth and sufficient bulk strength within itself to endure; and (3) the preservation of the vitality of the dental pulp first by means of conserving as much sound interjacent dentin as possible, and then by using proper basing techniques.

As a dentist goes about the task of placing restorations in a wide variety of teeth over his lifetime, the opportunity to prepare ideal "textbook" cavity preparations may not occur frequently. More often than not, the carious lesion will have already invaded the tooth well into the interjacent dentin, or, where a defective restoration is being replaced, the depth of the previous cavity preparation may have already gone beyond the ideal position of the axial wall. Nevertheless, the dentist should always be mindful of the ideal position of the axial wall and use this position as a guide when placing line angles, point angles, retention angles, pin holes, retentive pins, bases, and other devices useful in the process of restoring the tooth. By holding steadfast to the concept that the ideal position of the axial wall has this important and fundamental function in all cavity preparations, the dentist will find that the restorative process in dentistry can take on a new meaning, be more exacting, more successful, and in the long run, be more enjoyable.

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INTRODUCTION

> And—
>
> A fifth wall, called the axial wall.
>
> RULE: That wall of a cavity in an axial surface of a tooth that covers the pulp is called the axial wall. If the pulp of the tooth is removed, the cavity is extended to include the pulp chamber, and the wall takes the name of the wall of the pulp chamber (Black, 1908).

Because of the work of Dr G. V. Black, the axial wall has been well known to every 20th-century dentist as one of the walls of certain cavity preparations. Black defined this wall, along with all the other walls, line angles, point

angles, and cavosurface angles, in his texts on operative dentistry. Since that time, volumes of information about cavity preparation have been written and illustrated in textbooks, journals, and manuals. In addition, cavity preparation has been thoroughly taught in dental schools, and has been a favorite subject for lectures and clinics at professional meetings.

However, within all this massive effort to teach, clarify, and improve the technics of restorative dentistry, the role of the axial wall has never been singled out and discussed in a manner befitting its fundamental importance in cavity preparation. Most authors have quoted Black's original definition (Davis, 1916; Gilmore, 1967; Hampson, 1973; Howard, 1973; Johnson, 1923; Weeks, 1911; Messing & Ray, 1972; Simon, 1956). We hope the concept presented in this article will be useful in emphasizing the importance of the axial wall.

Axial Wall Defined

The axial wall is one of the internal walls normally occurring in Class II, III, IV, V, and certain Class I cavity preparations. More specifically, axial walls are found in cavity preparations that involve the axial surfaces of teeth, namely, mesial, distal, lingual, and facial surfaces. The axial wall is the innermost wall of the cavity, nearest the pulp chamber. It is always parallel to the long axis of the tooth.

Importance of Position and Contour of Axial Wall

The position and contour of the axial wall is of utmost importance when one prepares an ideal cavity. The position at which the axial wall is established represents an acceptable depth or extent of penetration of the cavity into the axial surface of the tooth. The horizontal curvature or convexity of the axial wall is important in maintaining proper axial depth. Because this curvature causes the axial wall to parallel the dentinoenamel junction, the depth of the cavity will be constant throughout the axial part of the preparation. Whenever an axial wall is prepared straight or concave in relation to the curvature of the dentinoenamel junction, the depth of the axial part of the cavity preparation will not be constant.

As a result of the work of G. V. Black, mortise or box form has long been considered essential for good cavity preparation. Of all the walls in a prepared cavity, it is the axial wall that completes and perfects the mortise or box form of the cavity. If the axial wall is improperly placed, poorly contoured, or is missing entirely, the desirable aspects of mortise form will not be present. If, on the other hand, the position, plane, and contour of the axial wall are established properly, all other aspects of the cavity preparation (other walls, line angles, point angles, and cavity depth) will assume a proper relationship and balance to each other, and good mortise or box form will be present (Fig. 1).

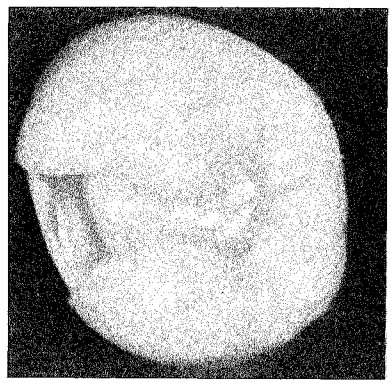


FIG. 1. Cavity preparation showing good mortise form. Note the axial wall following the anatomical contour of the tooth.

Concept of Axial Wall

Although the axial wall is not a natural anatomical structure of the human tooth, it is worthwhile for the dentist to view this wall as being anatomical. Each time an ideal cavity is prepared in one or more of the axial surfaces of a tooth, the axial wall should be established at the same internal depth, regardless of which axial surface is being prepared.

To illustrate this point, if the crown of a human tooth were horizontally bisected, three basic anatomical parts of the tooth (enamel, dentinoenamel junction, and dentin) may be visually identified (Fig. 2).

If, before sectioning this tooth, ideal cavities were prepared on two of the axial surfaces, the tooth would appear as illustrated in Figure 3A. Note that the natural anatomical structures are

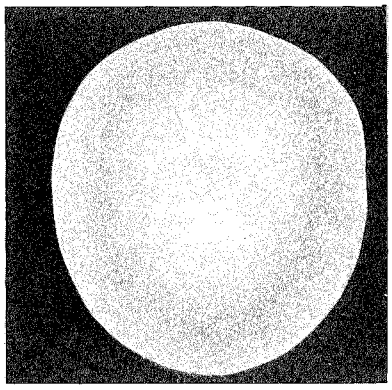


FIG. 2. Horizontal cross section of a tooth

the same as before. However, new structures have now appeared—the walls, line angles, and point angles found in each of the axial surface preparations. Observe the position, plane, and contour of the axial wall in each of the preparations.

If ideal cavities had been prepared on the mesial, distal, facial, and lingual surfaces before sectioning the tooth, it would appear as illustrated in Figure 3B. Note that, regardless of which axial surface received a cavity preparation, the axial wall has been maintained at a constant depth, plane, and contour inside the dentinoenamel junction.

If the four cavity preparations were to be joined so that one cavity preparation extended around the tooth, the axial wall should appear as illustrated in Figure 3C.

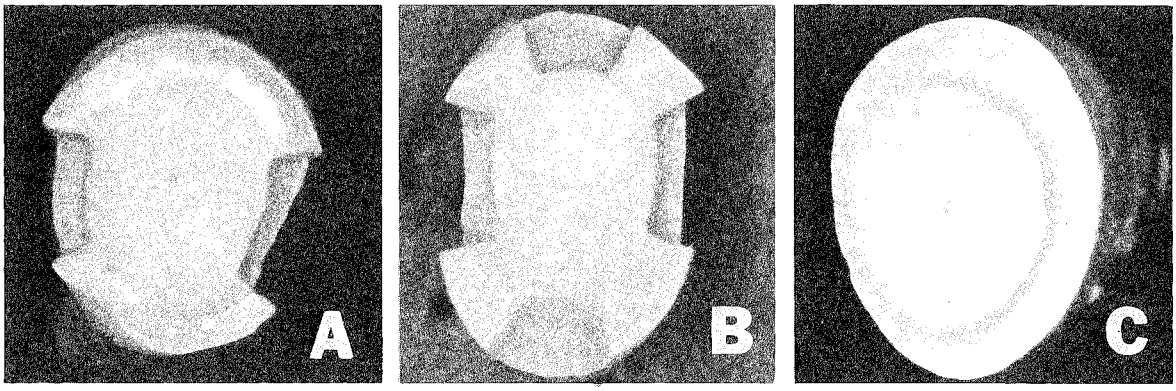
The significance of this concept should now become apparent—the axial wall can and should be thought of as a cylindrical "structure" existing within the axial surfaces of all teeth. Its position should be viewed as being at a specified depth inside the dentinoenamel junction. Although axial depth may vary with the thickness of the enamel, this concept suggests that the stated depth and position of the ideal axial wall will be fairly constant within all the axial surfaces of an individual tooth. Furthermore, this wall will be in the vertical plane, parallel to the long axis of the tooth, and its horizontal contour will parallel the curvature of the dentinoenamel junction and external surface of the tooth.

Depth of Axial Wall

At what depth should an ideal axial wall be placed? Although each dentist will use a cavity depth that is satisfactory for his own purposes, two fundamental criteria should be satisfied when establishing the position of the axial wall. First, whenever possible there should be approximately 2 mm of dentin between the axial wall and the pulp chamber. It has been shown that this thickness of dentin will provide an adequate protective barrier between the restorative process and the dental pulp (Stanley, 1971). The second criterion is that there should be sufficient dentin externally from the axial wall, or between the axial wall and dentinoenamel junction, so that line angles, point angles, retention angles, and other devices useful to the restoring material might be placed in the facial, lingual, and gingival walls without undermining the enamel. A suggested depth that will satisfy these criteria is within a range of 0.5–1 mm inside the dentinoenamel junction as measured from the dentinoenamel junction on the gingival wall.

There may appear to be a small increase in

FIG. 3. The development of the axial wall as it would appear circumferentially



the depth of a prepared axial wall as it extends occlusally from the gingival wall. This is because the axial wall is straight occlusogingivally. Because it is in the vertical plane and parallel to the long axis of the tooth, the axial wall may not be exactly parallel to the vertical or occlusogingival contour of the dentinoenamel junction or external surface of the tooth.

Interjacent Dentin—A New Term

Interjacent dentin may be defined as the dentinal portion of tooth structure within an ideal cavity preparation that is between and at the same time adjacent to the axial and pulpal walls, and the pulp chamber. The external limits of interjacent dentin are the ideal positions of the axial and pulpal walls. The internal limit is the pulp chamber. Interjacent dentin, then, is essentially the small segment of internal dentin separating the restoration from the dental pulp (Fig. 4).

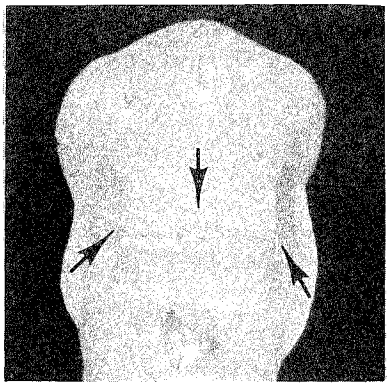


FIG. 4. Interjacent dentin (arrows)

Role of the Axial Wall in Preserving Interjacent Dentin

The definition of interjacent dentin as stated places this segment of dentinal tooth structure pulpally to the ideal position of the axial and pulpal walls, and therefore beyond the limits of formal cavity preparation. In other words, formal cavity preparation should stop at the ideal position of the axial and pulpal walls. The walls that are so often developed further into a cavity preparation as a result of the removal of a deep carious lesion are not axial and pulpal walls. They should be thought of as interjacent dentinal walls, and there should be no attempt to place line angles, point angles, retention angles, or other devices associated with the cavity preparation and restoration at this depth (Fig. 5).

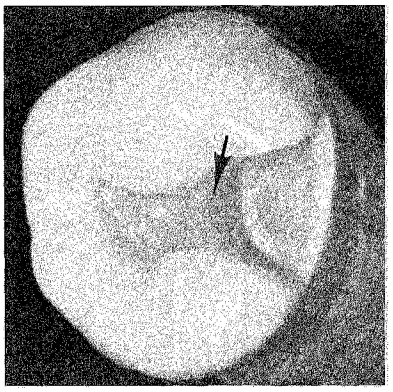


FIG. 5. Interjacent dentinal (arrow) after removal of carious lesion

Purpose of Preserving Interjacent Dentin

The purpose of preserving as much sound interjacent dentin as possible during cavity preparation is to maintain the essential functions of this segment of dentin. The interjacent dentin is the only substance that can effectively serve as a strong interconnecting link between the facial and lingual cusps of the tooth. As the depth of the axial and pulpal walls increases, the area of interjacent dentin decreases proportionally. The support imparted to these cusps by the linkage furnished by this segment of dentin also decreases.

Interjacent dentin is the best material to use as a substructure for the restoration. Vital dentin has both a firmness and resiliency that gives it an advantage over any other material as a supporting base for a restoration.

The preservation of interjacent dentin during cavity preparation will maintain the broadest possible barrier of natural, sound tooth structure between the restoration and the dental pulp. Therefore, the segment of interjacent dentin should never be cut into or otherwise removed during the process of cavity preparation, unless the dentin within this area is carious, or adversely affected by the carious process.

Excavating or removing carious interjacent

dentin should be done simply and carefully with spoon excavators and large round burs. The excavated area, then, needs only to be covered with an adequate layer of an acceptable therapeutic and insulating base (Fig. 6).

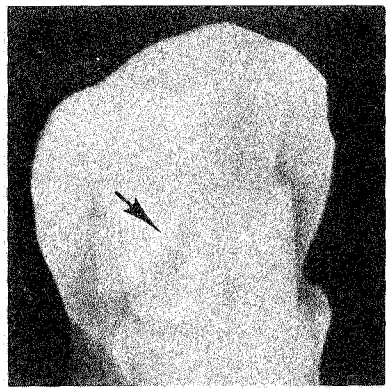


FIG. 6. Protective base covering interjacent dentinal walls (arrow)

Although sound basing techniques are essential to the restorative process, it is usually not necessary to replace a lost axial wall and excavated interjacent dentin with an equal quantity of a dental cement. Dental cements are unable to imitate the physical properties and physiological functions of healthy dentin. Indeed, large cement bases usually contribute very little to the success of a restoration. A large base in a cavity preparation is more apt to cause the restoration to fail, thereby endangering a pulp for which the base was placed originally to protect.

Nonideal Cavity Preparations

A knowledge of the importance and function of the axial wall in cavity preparations can best be gained from a study of ideal cavity preparations. However, the greatest value of this knowledge lies in its application to cavities that are not ideal, but instead are complex restorative problems.

Although the axial wall and much of the interjacent dentin in a complex cavity preparation may have been lost because of the removal of a deep carious lesion, the location of the ideal position of the axial wall is never lost. It is this ideal position of the axial wall that the dentist should keep in mind and work from when determining resistance form, retention form, and the placement of pin holes, retentive pins, grooves, dovetails, and basing materials. The ideal position of the axial wall offers guidance for the safe placement of all devices useful to the support and retention of a restoration. At the same time, the ideal position of the axial wall will indicate the amount of interjacent dentin that has been removed, and can be a guide as to the method and amount of basing that is to follow.

References

BLACK, G V (1908) *Operative Dentistry.* Vol. II, p. 7. Chicago: Medico-Dental Publishing Co.

DAVIS, W C (1916) *Essentials of Operative Dentistry.* 2nd edition, p. 23. St Louis: C V Mosby.

GILMORE, H W (1967) *Operative Dentistry,* pp. 71-72. St Louis: C V Mosby.

HAMPSON, E L (1973) *Textbook of Operative Dentistry.* 3rd edition, p. 15. London: W Heinemann Medical Books.

HOWARD, W W (1973) *Atlas of Operative Dentistry.* 2nd edition, p. 6. St Louis: C V Mosby.

JOHNSON, C N (1923) *A Textbook of Operative Dentistry.* 4th edition, p. 153. Philadelphia: P Blakiston's Son.

MESSING, J J & RAY, G E (1972) *Operative Dental Surgery, p. 93. London: Henry Kimpton.*

SIMON, W J, ed. (1956) *Clinical Operative Dentistry,* p. 27. Philadelphia: W B Saunders.

STANLEY, H R (1971) Pulpal response to dental techniques and materials. *Dental Clinics of North America,* **15,** 115-126.

WEEKS, T E (1911) Technique of cavity preparation. In *The American Textbook of Operative Dentistry.* Kirk, E C, ed. Ch. 7, p. 189. London: Henry Kimpton.

SPECIAL ARTICLE

Avoiding Future Shock in Operative Dentistry

Change is inevitable but too much change too rapidly can be destructive.
Dentists should try to control the direction
of the changes confronting dentistry.

W N VON DER LEHR

Summary

Future shock is the stress and disorientation produced by too much change in too short a time. Much of the pressure for change in dentistry comes from outside dentistry. Dental schools are pressured by the government, state boards of dental examiners, the American Dental Association, the American Association of Dental Schools, the alumni, and the medical center among others. Pressure on dentistry itself comes from inflation, patients, payment by third parties, the Internal Revenue Service, denturists, and dental assistants. Future shock can be avoided not by resisting change but by directing it.

Dental schools are abandoning the three-year curriculum and recognizing the problems of self-instructional teaching, self-paced curriculum, and computer-assisted instruction.

Expanded duty dental assistants are likely to disappear when no one hires them. Plans of payment by third parties have been modified through the efforts of dentists. Regulations for the handicapped pose problems for some schools, and regulation of medical devices is a new departure.

To avoid future shock dentists must participate more energetically in the affairs of dentistry.

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Presented to the Academy of Operative Dentistry, February 3, 1978, in Chicago.

INTRODUCTION

'Future shock' is the term coined by Toffler (1970) to describe the stress and disorientation induced in a person by too much change in too short a time. Future shock is a disease of change. Toffler characterizes change as "the process by which the future invades our lives." He advises that "it is important to look at it [change] closely, not merely from the grand perspective of history, but also from the vantage point of the living, breathing individuals who experience it." Toffler points out that

there are two facets of change that affect us all —the **rate** of change and the **direction** of change, which differ in their implications and effects.

THE PAST

An examination of the past may give some clues to changes we can expect in dentistry but such an exercise has a flaw in that we can ascertain the changes but not the rate at which those changes take place. We are now witnessing substantial change and it is evident that the acceleration of change is a fact of modern life. Dentistry, comprising a small coherent group of dedicated people, has been able to control change in certain respects. Communication within the profession has been good, and I believe the profession as a whole to be conservative.

Pressures on Dentistry

The pressures faced by dentistry come not from within, but from without. This is not to say, however, that the divisions of dentistry do not exert pressures on each other. A look at the past few years might show that the formation of the Academy of Operative Dentistry resulted from such pressure. Many feel that we have lived through an era of a declining image of operative dentistry, an era in which we have witnessed a loss in prestige and certainly, in educational institutions, a loss of curriculum hours. Administrators have given many reasons for the declining attention to operative dentistry but, nevertheless, many of us have experienced the frustration of trying to teach more in less time. We see now a return to a demand for expertise in clinical operative dentistry, perhaps again from outside pressure.

Pressures on Dental Schools

As I see them, the outside pressures on dental schools are the following:

- First there was pressure from the Department of Health, Education and Welfare to institute the three-year curriculum, which was made attractive by capitation support. Many schools chose to follow this route. When a curriculum that was already overloaded was compressed into three years, operative dentistry, as well as other clinical disciplines, lost much laboratory, lecture, and clinical time.
- Another institution that exerts pressure on dental schools is the state board of examiners. State boards traditionally give greatest emphasis to operative dentistry, since these operations can be accomplished more easily within the time available for a board examination. When the failure rate of graduated dentists began to climb alarmingly, school administrations were quick to examine programs in operative dentistry and make adjustments. This might be considered a positive pressure on dental education, at least at the clinical level.
- Other pressures came from the American Dental Association, the American Association of Dental Schools, the alumni, the medical center, and elsewhere.

Other Pressures

Pressures on dentistry itself, not just on dental education, can come from an ever-increasing financial inflation, from patients who say, "I love you as a person but I hate dentists," from payment plans by third parties, the Internal Revenue Service, denturists and dental nurses, and what have you.

The pressures themselves do not cause the problems within us, it is the reaction to the pressures. Our reactions often take the form of stress. We are stressed because these pressures mean changes and more changes, and the acceleration of change pushes us toward future shock. As Toffler states, "Future shock is the dizzying disorientation brought on by the premature arrival of the future."

THE PRESENT

Let's look at the present. How do we stand? Problems? Sure. Pressures? Absolutely. Conflicts? You bet. Heading into future shock? Probably. But I think we, in dentistry, have a great deal on our side. To quote again from Toffler, "Most of the problems besieging us, including future shock, stem not from implacable natural forces but from man-made processes that are at least potentially subject to our control. The answer to future shock is not non-change, but a different kind of change."

Changes in Dental Schools

This kind of change is going on in dentistry today. Schools are learning to live with outside

pressures. Many schools have departed from the three-year curriculum; others are planning to restore the four-year curriculum, after a few years of experience at the three-year level. Even the University of Tennessee, the granddaddy of three-year programs, is moving into a four-year plan.

Educational institutions on the whole are, in my opinion, facing the "different kind of change" referred to by Toffler. Many schools plunged into rapid changes and made sweeping innovations in the curriculum. The government offered vast sums of money for bricks and mortar and was interested in promoting much change—change that could be interpreted as change for change's sake. My impression is that this trend has righted itself. Schools that were quick to try innovations were just as quick to reverse themselves when the faculties asserted their belief that the system was not giving the best results. They took the best from the innovations and threw out the parts that were only burdensome and not progressive. Self-instructional teaching was found to be ineffective or to be effective to a limited degree; instead of replacing faculty, as first thought, self-instructional teaching required more faculty and required the faculty to function at a high level of efficiency. Self-paced curricula were just an opportunity for students to loaf—not to learn. Computer-assisted instruction was so exciting, but so expensive, and it will not replace the instructional arrangement of student-faculty-patient in the clinic. It is not all bad, nor is it all good. Faculties have learned from the experience and the profit is great. They have learned from the changes and used the learning to benefit not just education, but dentistry across the board.

Expanded Duty Dental Assistants

Let's see what the present looks like for the private practitioner who was incensed a few years ago by the threat of EDDA, the expanded duty dental assistant. This was going to turn private practice into assembly line dentistry! The very foundation of dentistry was being eroded. My first feeling was panic—future shock set in, but then some time passed. Many of us began to look at and to assess the problem and its many facets. In the first place, can operative dentistry be taught to auxiliaries? Yes, I believe it can. Some can learn rather quickly to place, carve, and polish; but remember, the operation has to be routine. What happens if something unusual develops? I was in private practice for 14 years and I recall few days when the unusual did not happen. Dentists make so many decisions automatically that we forget what a complex, task-oriented computer an operative dentist is. This we can't teach to auxiliaries. Suppose auxiliaries were available and that state laws would allow us to use them, would you hire one, or two, or three? Do you want the hassle, the expense of multiple operatories, the employee problem, absenteeism, and the paper work? Do you want to be a foreman in this factory? I think not. The idea of EDDAs will fail when no one will hire them.

Payment by Third Parties

What about payment by third parties? This was another threat to dentistry. This usurped the relationship of doctor to patient. Everyone talked about preauthorization, coinsurance, percentages, coverage, and claim forms. The rate of change was not as swift as everyone had estimated and the direction of change was controlled by dentistry. Sure, compromise was necessary. Labor unions, insurance companies, state committees on prepayment, and the American Dental Association became deeply involved in hot conflict, hours of discussion, and much soul searching. As the years have gone by, we still have some third-party problems, but we still have third-party payment and it is here to stay. Dentistry engaged actively in this struggle and we changed the direction of change. We influenced some insurance companies and they had to learn some dentistry. It is my feeling that **they** have been more resistant to change than we have. There is much to be done, and in the future we hope that dentistry can use the system to treat patients more effectively. The patient is our concern, and remember, patients cannot be treated without us.

Regulations for the Handicapped

Another area of problems and interest is the new regulation for the handicapped. Did you know we can no longer ask a dental school applicant the state of his health, or if he has

any handicaps? We can't legally refuse admission to anyone because he has no legs, or hands, or eyes. Some schools could be faced with massive rebuilding plans because every course must be taught in a place that will not prohibit a handicapped person from attending. In modern schools with many elevators this is not a problem, but it is a concern to admission committees. The American Association of Dental Schools is looking at the problem with a view to defining handicaps in dentistry. This is an extremely complicated task. For example, how blind can you be and still practice dentistry? Do you need two eyes or just one? How much do you have to hear? How many fingers does it take to practice dentistry? Do you need legs?

There are many other problems we must deal with. There is now talk of advertising. There are great concerns about hazards in dentistry, such as mercury contamination and hepatitis; the Louisiana State University School of Dentistry has shown that 1.7% of all new patients have hepatitis. How sterile can we be in the mouth? How can we sterilize handpieces, dental units, and counter tops? Does our water spray have contaminants? Will OSHA (Occupational Safety and Health Administration) make demands we can't meet?

Regulation of Medical Devices

Consider legislation for medical devices. This is now with us, though the effects are not yet being felt by the private practitioner. On May 28, 1976, the President signed this legislation into law. It is called the Medical Device Amendments. When the government steps in things get wordy. A good example is the definition of a medical device. It reads, and I quote from the law, "A medical device is an instrument, apparatus, implement, machine, contrivance, implant, in-vitro reagent or other similarly related articles including any component, part or accessory which does not achieve any of its principally intended purposes through chemical action within or on the body of man or other animals and which is not dependent on being metabolized for the achievement of its principally intended purpose." Now you know what a device is. The sense of it is that the difference between drug and device rests on the words 'chemical action' and 'metabolized'.

The legislation established panels for the specialties in medicine. There are currently 19 panels, dentistry being one. As a member of the Council on Dental Materials and Devices, let me say that none of these regulations is particularly threatening to our profession. The Council has been making similar efforts since 1966 and the Federal Drug Administration has indicated that it would like the Council to assist the Dental Panel in reviewing products before they are marketed as well as with standards for materials and devices. Once again dentistry is in on the ground floor and is being asked to participate. The regulations of the Federal Drug Administration on safety and effectiveness will have the same significance for manufacturers as did regulations covering pharmaceuticals. I don't think the dentist in practice will be seriously affected by these regulations. True, clearance of products that need scientific review before being placed on the market will delay the introduction of new products, but the added scientific testing will not differ substantially from the voluntary program now required by the Council on Dental Materials and Devices.

I'm an eternal optimist—almost to a fault—but I am not without concern about all this regulation by the Federal Drug Administration. I have many concerns and I'll express them.

- **Panels:** The panels consist of members that include clinicians, researchers, a consumer representative, and an industry representative, all serving three years. My concern is with the weakness of committee activity. We all serve on many committees and I'm sure each of you must question the results, at least occasionally. I'm reminded of the old adage, "A camel is a horse that was designed by a committee." You know how it works. Insignificant things can be discussed for hours, and important items can be skirted or overlooked. Often a committee can be dominated by a splendid orator or a commanding personality. People on committees must be dedicated to getting the work accomplished, but all of them have other jobs that take priority.

- **Input:** Each panel meeting, including the agenda, is announced in the Federal Register. Professional, industrial, and lay people are encouraged to attend and participate. Now I know all of you read the Federal Register regu-

larly and have the funds to fly to Washington just any time. The profession must watch carefully to use its opportunity for input. I fear this will be difficult, but the councils of the American Dental Association will be there representing us all. Makes your dues to the American Dental Association seem a little more important, doesn't it?

• **Dilution:** Dilution of important items into a morass of the unimportant is a danger ever present. For example, the list of dental devices when I last saw it contained 313 items. Included with such items as analgesia flowmeters, resuscitation devices, x-ray systems, and handpieces were cement spatulas, tongue depressors, and paper cups. I feel sorry for the current panel, but my heartfelt thanks go out to them all. May they have the strength of Hercules and the wisdom of Solomon.

THE FUTURE

Enough for the present. Let's look into the future. I'm not smart enough to make predictions and I'm not going to attempt them. But I want the future of dentistry to be secure. I want the future of operative dentistry to be secure. Let me quote from *Robins Reader*:

> It is probable that we are going to have to retool our thinking about a lot of things in the years ahead. It might be smart to start the process gradually . . . to try to think a little ahead of our time. A good way to begin might be to ask ourselves, every once in a while, how will this idea I'm so sure about now look to people with a century more experience than I have had?

Maybe we shouldn't worry about OSHA, FDA, IRS, HEW, and FBI, but should narrow our field of interest—not dentistry, but operative dentistry. Can we do something to enhance operative dentistry's future? Can we avoid future shock in operative dentistry? I think we can. There's the optimist again. And I'm convinced we will. We are now working hard at this and we will continue to improve our situation.

Participate in Dentistry

Let's examine how to go about it. First, we have to participate. Be active in your dental organizations. Attend programs of continuing education—participate. Form your own study club. Next—read. Read the journals; look up the references. Stimulate yourselves. There are several new textbooks on operative dentistry. Have you read any of them? The American Dental Association has a lending library from which you can get articles as well as books. And how about writing? Didn't you always want to write an article? If you just can't get going alone, find a colleague who can write. Put down your ideas and discuss them with him. Then you can co-author an article. If you can't seem to work it out, perhaps you should plan a table clinic. Take that unique idea, that clever little trick, or that new approach and design an informative table clinic. Most meetings need table clinics and it's fun to share your ideas with your fellow practitioners.

Maybe you would rather speak. Don't be embarrassed to admit you have a flair for drama or public speaking. There are many of us who have a little "ham" in our souls. It's really easy to begin, but it can get hard to control. When I was in private practice I was a Kiwanian. I worked up a little presentation about dentistry and I talked about what's new in dentistry, such as ultra speed, new impression materials, porcelain fused to gold, fluoridation, and so on. The presentation made many friends for dentistry and as a result I was asked to speak to other groups. You can speak to women's clubs about dentistry for children and speak to educators about prevention. You can all relate stories about something or other that has happened to you in dentistry. Let it be known that dentists are human and that we care about people.

Research

It's now time to talk about another facet of dentistry that directly affects its future and can enhance the position of operative dentistry in the future. I'm speaking of research. We do many things in operative dentistry for which there has been no research. We do them because they seem right or logic tells us they are correct, but I should really like to know with proof that A is better than B. Not to imply that B is not also clinically acceptable, but that A is better; for example, cutting dry or cutting wet. You say, "Oh you can't cut dry, that would injure the tooth." There are many that do cut dry. In at least one dental school teeth have been cut dry for years with no untoward results. I

would like to know which is best, by how much, and why.

Another example is rounded line angles. Yes, I teach them, but I'm hard pressed to prove to my colleagues that rounded angles are best. Stress studies show they are best, but these are mechanical studies. What about the tooth? I wish we could design a study on vital teeth. How about retentive grooves in the proximal box? You have to have them, you say! There are at least two schools that don't teach the use of proximal grooves and these schools produce excellent amalgams.

Consider cement bases under amalgam. Are they really necessary or will a liner suffice? Thousands of practitioners have abandoned the use of bases to restore the ideal cavity preparation before placing an amalgam. Is this best? I don't think so, but I don't know. I know of one study that shows that if a base has more elasticity than amalgam, the amalgam will fracture when loaded with occlusal forces, unless it has unusual bulk.

Just to accent the point, let me remind you that when a new alloy came on the market a few years ago, some excellent researchers began to investigate its performance. In doing so they compared it with other alloys then in use. Does it surprise you to know that the worst alloy in the studies was the largest selling alloy at that time? That to me was shocking.

There is much that is new in operative dentistry and research is continually going on. We have new cements, new preparations, new alloys, and a technic of etching enamel. There are improvements in foil and we are burnishing amalgams, but there is much more to do.

John Greene (1977), Chief Dental Officer of the US Public Health Service, speaks well for us as he describes the creative use of tensions:

> . . . the pressures to change and revitalize and upgrade are intense [today]. Health sciences are among the prime targets. . . . [It's] not growing cynicism toward American institutions and . . . values. It's . . . a reaffirmation of faith in our ability . . . to improve the quality of life. We know that roughly half the population has access to fluoridated water—up from none about 30 years ago. . . . About 50% see a dentist in a year—and that's a good 15% better than the record of a decade ago. Children are getting fewer cavities; fewer cavities go untreated. The number of old people who are edentulous is also declining. We are living longer . . . proof of the skill and dedication of American dentistry and medicine.
>
> And so what matters most to us now are the 50% who do not have fluoridation or who do not see a dentist, or the children and old people who still suffer from the worst kind of neglect. . . . How dentistry as a whole reacts . . . to the solutions proposed to the problems . . . is a matter of some importance to the future in health. . . . The very process of debate will create tensions among us. They can be creative tensions, however, and through them, if we are wise, we will learn to make the accommodations from which real progress can spring.

CONCLUSION

I hope by now you might be feeling a little tension, a little vagueness in the pit of your stomach. I want you to feel what I'm saying, because if I can create some tension in some of you something will happen. Make use of that tension. Let it be creative. Let it affect the direction of change.

References

Federal Food Drug and Cosmetic Act as Amended (October, 1976) Washington: US Government Printing Office.

GREENE, J C (1977) The creative use of tensions. *ADA News,* **8** (25), 2, Dec 12. (Excerpts from a commencement address delivered at the University of the Pacific School of Dentistry, June 17, 1977. The complete text of Dr Greene's talk appears in the school's publication, *Contact Point*, **55**, 5–9, 1977.)

Robins Reader (1977) No 4. Richmond, VA: A H Robins Company.

TOFFLER, A (1970) *Future Shock.* New York: Random House.

POINT OF VIEW

The Dental Patient Has a Problem

In his search for good dental treatment the patient is handicapped by his lack of knowledge of good dentistry.

RICHARD V TUCKER

How many times have you wondered what the patient would think if he or she had your knowledge of dentistry, yet received the type of restorative dental care that we see so often in the mouths of our patients?

It is unfortunate that, although good dental health is considered essential to nearly everyone, few people know what it is, or how to get it. They innocently place the care of their mouths in the hands of someone whose credentials they probably investigated very little.

At a recent annual meeting of the Associated Ferrier Study Clubs it was reported that a computer readout involving an enormous number of patients in California disclosed the following facts. The average length of time a full veneer crown lasted was between two and three years. The average bridge lasted three to four years before replacement. This is hardly a testimonial to fine restorative dentistry.

The problem is complicated by the fact that it is difficult for a patient to evaluate the quality of dental operations involving marginal integrity, proper contours, occlusal harmony, and many other factors. As a result, the dentist is evaluated by other criteria which the patient better understands, such as friendliness, a handsome office, or lack of pain in treatment, all of which are important but contribute little to high quality dental care. The quality of restorative dentistry is not empirical and does not adapt to the usual measures of control; thus the patient has difficulty in knowing whether or not he has received good treatment.

It would seem reasonable that a patient, who cannot properly evaluate restorative dentistry

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for himself, could at least depend upon the dental profession or a peer review committee to eliminate from practice those dentists who perform their operations poorly. To some extent this is true in that a few grossly inept or disabled dentists might be eliminated from practice. However this would not help the patient who is seeking dental care of high quality.

There is recent concern that the nation's judicial system will strike down state laws that prevent commercial advertising by dentists. Such an action would also require removal of the advertising clause in the codes of ethics of dental associations. Of course the public could hardly be expected to understand the implications of such a "consumer interest" cause. To those who really know the dental profession it is obvious that advertising would promote the interests of those dentists who would compromise quality of care. If this were not true, advertising would be unnecessary.

Too many unknowledgeable and unsuspecting dental patients allow themselves to be herded through a production-line office in the name of efficiency, probably without even the satisfaction of less cost. Unfortunately for the patient cheap dentistry does not necessarily come at a cheap price.

In spite of our shortcomings, the patient still must turn to us in the profession to solve his problem. Most would prefer dental treatment of fine quality if they knew what it was and how to get it.

For a start this is what we should do:

1. Educate people through the media and in our offices about the particulars of good dentistry so they can appreciate and demand it.
2. Cooperate with peer review in spite of its inherent weaknesses.
3. Help educate patients to seek dentists by referral.
4. Ask our nation's dental schools to place a renewed emphasis on teaching restorative dentistry of the highest quality and attempt to instill in each student that illusive quality and discipline that causes him to accept only the very best from himself while he practices his profession—a very difficult task for our schools.

Yes, the dental patient has a problem in obtaining restorative care of fine quality though he may not know it. Let's help him solve it.

Letter from Europe

In this column I plan to give the readers of *Operative Dentistry* some idea of the trends in dentistry in the Western European countries. I hope this will become a regular and popular feature. In this first letter I should like briefly to describe current developments in dental education in the Netherlands.

This year a unique event occurred in the Netherlands—the Netherlands Dental Association celebrated the one hundredth year of dental education, 1877–1977. After the initial ceremonial protocols, past achievements were assessed.

The first and oldest dental school is that of Utrecht, which first admitted students in 1877. Since World War II four new dental schools have been established—two in Amsterdam, one in Groningen and one in Nijmegen. None of the schools enjoys total autonomy because each is part of a medical school and educational responsibilities are shared.

Up until now, the duration of dental studies has been six years. This undoubtedly has resulted in a slow turnover of dental students. With a population of 13 million the ratio of dentists to patients is approximately 1:4500. There is no limit on admissions, so most of the schools are overburdened with students and deficient in numbers of faculty.

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The educational climate is rapidly changing. Paradental personnel such as hygienists, dental assistants, and expanded duty auxiliaries are being trained on an experimental basis in the universities. Most of the dental curricula are under revision.

One interesting development in the teaching of operative dentistry has been the introduction of project ACORDE (A Consortium on Restorative Dentistry Education). Interest in this program was generated by Professor David A Grainger of the University of Florida, who in 1973 at the invitation of Nijmegen University presented a brilliant three-day seminar on curriculum planning, production, and implementation.

Schools are emphasizing more and more the concept of learning rather than teaching. It is clear that clinical activity in departmental isolation is giving way to comprehensive care in clinics. With the new curriculum, dental students begin a limited exposure to patients in the first year.

Prevention of dental disease constitutes the core of the new curricula. New teaching methodologies in dental education are being explored and thus there is emerging the concept of the center for independent learning, where students can use self-instructional materials for much of their studies.

The educational slogans of the seventies are flexible curricula, early graduation, self-paced learning, teamwork, and management training. The rapid changes represented by these slogans are creating the usual temporary storms of discontent and confusion but if we look beyond these we see a future of excitement and challenge.

ADAM J SPANAUF

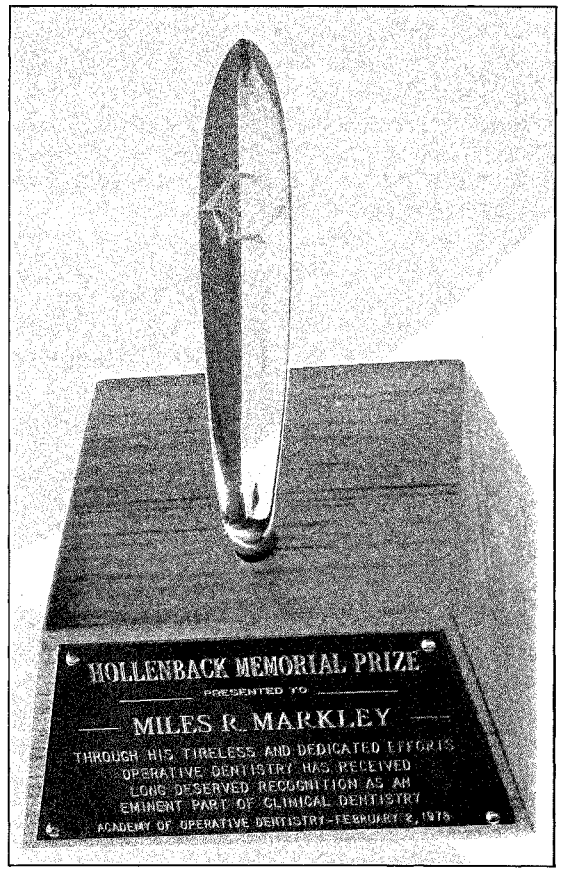
OPERATIVE DENTISTRY, 1978, 3, 28-30.

Hollenback Memorial Prize

Miles R Markley has won the Hollenback Memorial Prize for 1978. The prize is given annually by the Academy of Operative Dentistry to honor the recipient for accomplishments that have contributed substantially to the advancement of operative dentistry. Dr Markley won the prize not only for his outstanding leadership in restorative dentistry but also for his many years of distinguished service to dentistry as a whole.

Dr Markley obtained a DDS degree from the University of Denver and has remained in Denver in general practice, but a wide range of professional activities takes him far beyond that city. He is a Diplomate of the American Board of Prosthodontics in Fixed Prosthesis and a member of the American Academy of Restorative Dentistry. He is a Life Member of the Woodbury Gold Foil Study Club and of the Colorado Prosthodontic Society. He directed the Mile Hi Study Club in Denver and the Panhandle Region Study Club in Nebraska and is a member of the Columbine Periodontal Study Club.

Throughout the world Dr Markley is well known as an author and lecturer. He is an honorary member of the American Dental Society of Europe and a member of the postgraduate faculty at the University of Oregon School of Dentistry.



Dr Markley has contributed to dentistry on both national and state levels. He is a Fellow of the American College of Dentists. He is past president of the Colorado State Board of Dental Examiners and the dental associations of Denver and Colorado. From 1960 to 1970 he was National Consultant to the Surgeon General in Restorative Dentistry for the US Air Force and he has been Consultant to the Surgeon General in Restorative Dentistry for the US Army since 1946.

The influence of Miles Markley on modern dentistry is summarized by David Grainger: "It is largely through Dr Markley's efforts that Operative Dentistry was put on the map. . . ."

Response by Dr Markley

I feel deeply honored to receive the Annual Hollenback Prize for two reasons. First, that it comes from my many friends in this Academy. Second, Dr Hollenback was a guiding star in my dental career. George Hollenback's portrait is one of the four that flank my father's beside my desk.

During the depression years Dr Hollenback turned to amalgam as a restorative even though gold was considered king. His practice numbered many well-to-do people who could afford gold. But he sensed the value of amalgam as an excellent restorative rather than as a compromise substitute.

He studied and perfected ways to make it better. Once he found something superior, he shared it with his fellow dentists. In the early thirties he came to Denver to lecture on amalgam. While there, he demonstrated his methods to a group clustered in a Denver dental office. It was my good fortune to be included.

I had learned to make a fairly good cast restoration in dental school. But my early amalgams were dismal failures. Many people could not afford gold inlays during the depression. Dr Hollenback taught us how to build a good amalgam, and assured us that the material justified a careful technic.

I had discarded the rubber dam for amalgam. He taught us that a completely dry field was essential to a quality restoration for four reasons:

1. A damp cavity means a leaky filling.
2. Moisture contamination causes pits and voids that foster corrosion of the amalgam.
3. Any moisture at all prevents stabilizing a rigid matrix, so necessary to good condensation.
4. He started us toward building an anatomical matrix to yield contours comparable to good cast restorations. Such a matrix is possible only in a completely dry field.

From then on, I was able to deliver increas-

ingly better amalgams. Now we consider it the number one material for young people because it has a lifetime expectancy rivaling gold foil.

Hollenback researched all manner of dental materials, always from a practical viewpoint since he was a practicing dentist. I read his numerous articles avidly, and heard him lecture whenever possible. He invited me to spend several days in his office, with a visit to his home and famous workshop filled with instruments he had designed and built.

Through his teaching of sound principles and innovations, the entire field of Operative Dentistry prospered. He taught us in 1937 that every cast restoration must be relieved for cement. Without relief, no well-fitted casting will seat by some 150 microns. He showed me from his safe the dies and castings he had made to prove it.

He took time out of his practice to earn a master's degree from Northwestern University in 1945. That particular research studied how to best compensate the shrinkage of gold when cast. He invented vacuum investing of patterns and had simple equipment built for the technic. He designed the pneumatic gold foil condenser which would reach inaccessible linguals for more esthetic restorations. He researched all manner of impression materials, investments, stone, plaster, alloys, as new ones came on the market or were contemplated. He designed instruments and equipment and taught us to use them.

Your dental service to humanity, and mine, has been enhanced by his lifetime efforts.

Therefore, I receive this Hollenback Memorial Prize with deep feeling and appreciation.

Presented to the Academy of Operative Dentistry on February 2, 1978, in Chicago.

EDITORIAL OPINION

Hindsight or Failure?

H WILLIAM GILMORE

Editorial (Jan/Feb 1978) *Journal of the Indiana Dental Association* (57) 2.

The apprehension of beginning the year invites a look at the goals and the anxieties that could alter the profession. Twelve months appear to be a long time but they pass quickly and layer the progress that directs our lives. We are still told that inflation and unemployment are the main ills of society. It follows that we must again view the government-related programs that will attack these problems and that will eventually bring more regulation to the health industry.

The work of Pugsley in *Common Sense Economics* makes interesting reading. It is the author's claim that dozens of societies have been destroyed by inflation as far back as early Macedonia. The following is the sequence that has ruined many governments.

1. Government needs more money than it is able to collect through taxation, so it issues paper money.
2. When the government spends this new money business picks up.
3. As the increased supply of money percolates down through the society, prices begin to rise and business begins to slump.
4. To counteract the slump, the government issues more money.
5. Business picks up again, prices begin to rise, business slumps again.
6. People begin to distrust paper currency and begin to hoard gold and silver coins.
7. Government points finger of blame at gold hoarders and passes laws to stop hoarding, often confiscating gold and silver coins.
8. More inflation: prices begin to rise more steeply, people demand action and government passes price and wage control laws.
9. Shortages appear: rationing begins, black markets take over in place of regular markets.
10. Speculation begins to replace prudent investing as capital markets fluctuate up and down due to the business cycles.

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11. Hard work falls into disrepute; people get rich (or poor) speculating; the thrifty lose all to inflation; more and more people go on relief as production falls and inflation forces prices out of the reach of the elderly and marginal producers.

12. As more people go on relief, government must tax the remaining producers more heavily until they decide to stop producing, and the situation begins to compound itself.

13. Stock markets oscillate wildly up and down, and finally drop; marginal businesses fail; prices fall to natural levels; currency is devalued to real levels; debts are repudiated; the country begins again.

The threat is getting old but the National Health Insurance (NHI) bill will be on the early agenda of the next congress. The planners of the administration are writing the bill; supposedly it will be a consensus of a select panel, regional US hearings, congressional committees and HEW guidelines. In April 1976 President Carter in a speech about health care stated "We have built a haphazard, unsound, undirected, inefficient non-system which has left us unhealthy and unwealthy at the same time." With this understanding of the US system the NHI developments are not surprising. The federal planners want a good type European social system and others know that the best for consumers is the lowest priced quality product. This can only be found in free enterprise.

The NHI bill at inception is estimated to cost $145 billion. This means the 60 million families in the country would pay $2,600 per year for health care. To make it worse the poverty level families would be taken from this and the continued bureaucratic performance would inflate the costs many-fold in a short time, any NHI bill would be gross inflation, exactly the opposite of the last campaign promises and Congressional goals.

Who starts these ideas? Will this be good for the country or will the United States follow dozens of other societies to failure with such absurd economic practices? When the lawmakers understand this there are several core areas about comprehensive NHI that must be discussed.

Reference

PUGSLEY, J A (1974) *Common Sense Economics.* Santa Ana, CA: The Common Sense Press.

DEPARTMENTS

Press Digest

A possible fault in elastomeric impressions. Jacobsen, P H (1977) *British Dental Journal* (143), 250.

During the use of Permalastic, both light and heavy bodied, surface irregularities that had not been seen in the impressions were found on the stone dies. Examination of the impression after removal from the die disclosed corresponding depressions that had not been noticed earlier. When the depressions were probed they were shown to consist of an air pocket surfaced with light-bodied impression material. The air was probably incorporated into the impression material when it was mixed. The author recommends spreading the material as thinly as possible during mixing and gently rubbing the surface of the impression to disclose unsupported areas of light-bodied material.

The plaque-inhibiting effect of copper amalgam. Hyyppä, T & Paunio, K (1977) *Journal of Clinical Periodontology* (4), 231–239.

Cervical restorations of copper amalgam and silver amalgam were compared for accumulation of plaque in humans. The amount of plaque was determined by planimetry of stained areas on the restorations as recorded in photographs. Plaque was also collected from the surfaces of the restorations after two and three days and then cultivated. Copper amalgam restorations exhibited much less plaque than did silver amalgam restorations. There was no visible plaque on 12 copper restorations but two displayed small amounts, 1.93% of the total area of the filling compared with 58.07% for silver amalgam restorations. The microbiology studies gave a similar result as did observations with a scanning electron microscope.

Book Reviews

OCCLUSAL TREATMENT

By Norman R Arnold, DDS, MSc and Sanford C Frumker, DDS

Published by Lea and Febiger Co, Philadelphia, 1976. 163 pages. Illustrated. $13.50.

In their preface the authors state the intent of *Occlusal Treatment*: ". . . to provide the reader with an in-depth feeling for, and understanding of, the principles of occlusion, and to help provide him with the abilities:

1) to apply the principles to routine dentistry;

2) to examine for and detect occlusal disease or traumatism and to prevent it;

3) to perform a complete occlusal adjustment by selective grinding;

4) to recognize the completeness and correctness of such an adjustment."

The authors, who are periodontists, have set forth commendable objectives which they only partly fulfill in this book.

Their philosophy of occlusal treatment is described in Chapter 1. In Chapters 2 and 3 they effectively explain and illustrate their principles of the "cusp seat" and "lateral freedom." The cusp seat is a modified cusp-to-fossa occlusion at the maximum intercuspal

position (MICP). Lateral freedom is provision for unrestrained mandibular excursions by employing a lateral index, the authors' concept of posterior disclusion. In Chapters 4 and 5 they describe protrusive freedom and the establishment of occlusion on the anterior teeth.

In reading Chapters 1 through 5, the reader is distracted and perplexed, as the authors do not clarify the application of a basic principle of occlusion: all occlusal treatment is related to either centric relation or centric occlusion. Specifically, the reader asks to know if selective grinding has as its objective the achievement of the maximum intercuspal position at centric relation, or centric occlusion.

The sixth and final chapter, "Adjusting to Centric Relation," does partly clarify the author's perception and application of the basic principle mentioned above. The authors suggest using a long centric to provide freedom for the patient from the MICP at centric occlusion to centric relation (p 128). The succeeding paragraph, however, makes reference to the MICP at centric relation.

The authors acknowledge that the MICP can be forward of centric relation for some patients. They do not explain how eccentric interferences at the border position are detected when the patient is unable to begin a lateral border movement from the border starting position, namely, centric relation. The detection and elimination of such interferences are basic in selective grinding for a patient who bruxes. Perhaps this problem is dealt with by the following statement: "The cusp seat with its freedom area prevents any interference during a Bennett movement" (p 71).

Study casts are mentioned, but it is not explained whether casts are mounted or a set of casts is adjusted before beginning selective grinding.

The reader is told that it is much more reasonable for the dentist to eliminate the interfering inclines than for the patient to attempt to grind them away by bruxing (p 133). "The only risk he runs is that of wearing out his grinding stones, and they are easily replaced." The patient may feel otherwise.

A generous bibliography is included; there are no footnotes.

Arthur F Stamey

THE DENTAL CLINICS OF NORTH AMERICA: SYMPOSIUM ON CERAMICS

Vol 21, No 14, October 1977

Edited by R Sheldon Stein, DMD

Published by W B Saunders, Philadelphia, 1977. 192 pages. Illustrated and indexed.

This excellent volume is a combined study of the various aspects of creating a superior porcelain-to-metal restoration. The work includes an in-depth analysis of esthetics, studies of margins, the design and handling of framework, preparation of teeth, the nature of porcelain, and the current status of laboratory procedures. Work developed for the colloquium, "Dental Porcelain: The State of the Art, 1977," is included.

The illustrations for the most part vary from good to excellent. Most of the graphic material is well reproduced.

One's immediate reaction is that the title is a misnomer and should be changed to *Ceramo-Metal Restorations: A Symposium*. The common feeling today that this particular restoration is the sum total of the profession's solution to all problems is distressing. (The view that ceramo-metal restorations are the ultimate solution is one that insurance companies will support.) The volume does not include other systems of ceramics, for example, the wide variety of porcelain inlays, custom-made facings, or an analysis of the available stains, glazes, and washes. Comparisons of shrinkage should be included along with information on the solubility of any highly fluxed or fritted agents.

One of the greatest problems facing the patient today is the fracture of this type of unit. A solution other than the use of a composite repair, a total remake, or an overlay "V" type of crown with its obvious disadvantages would be welcome.

An unfortunate omission is the lack of illustrations showing the use of the rubber dam and a 212 clamp properly placed to protect both the patient and the gingival tissue, though several authors discuss means that might reduce laceration of the tissue.

The casting accuracy of the newer alloys is considered. However, the use of comparatively

soft stone dies which erode easily when handled is noted. These are nevertheless in current use. The old amalgam dies and silver-plated dies have a measure of control. Do they ensure greater accuracy?

The editor and contributing authors should be commended for their excellent work. The book could well be a text for ceramo-metal work; it certainly should be a required reference.

A few articles repeat ideas and techniques and some are a little verbose, particularly in the introductions. However most articles offer a great deal. Jack Preston's style and succinct thoughts particularly impressed the reviewer.

All in all this volume is essential for those interested in current procedures. It is a definite contribution to the literature.

Bruce B Smith

Announcements

NOTICE OF AWARDS TO BE GIVEN

Nominations Invited for Hollenback Prize

Nominations of candidates for the Hollenback Memorial Prize are invited by the Academy of Operative Dentistry. The prize is given annually for research that has contributed substantially to the advancement of restorative dentistry. The research may be either fundamental or applied and may deal with prevention of dental disease or its treatment. There are no geographic or occupational limits on eligibility for the prize and it will be accompanied by a monetary award.

Names of nominees and particulars of their research may be sent to Dr Anna T Hampel, Chairman of the Research Committee, Academy of Operative Dentistry, University of Minnesota, Minneapolis, MN 55455. Nominations should be submitted by June 15, 1978.

Achievement Award for Students

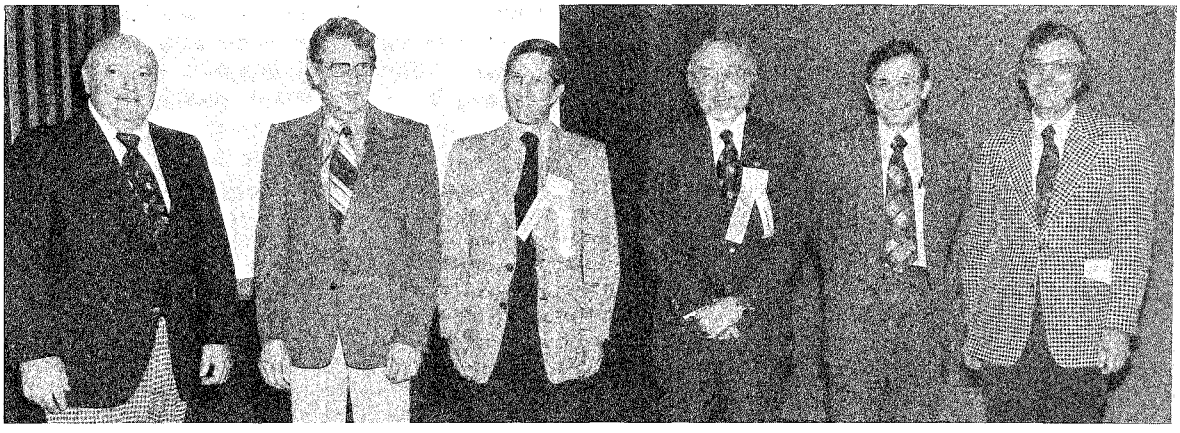
The Academy of Operative Dentistry will recognize outstanding achievement among dental students through an award for a table clinic. The awardee is to be selected from the Student Table Clinic Program at the annual meeting of the American Dental Association. The award consists of a certificate, $200, and a place on the Table Clinic Program at the annual meeting of the Academy in Chicago. Travel and expenses for the Chicago meeting will be paid by the Academy.

W Paul Whittaker, DMD

W Paul Whittaker, who practiced in Spokane, Washington, died November 29. He had been hospitalized since his return in early October from the Annual Meetings of the American Dental Association and the American Academy of Gold Foil Operators.

Dr Whittaker was born and raised in the wheat country of eastern Washington. He attended Washington State University and received his dental degree from North Pacific College in 1940. He joined the Navy soon after graduation and began private practice in downtown Spokane in 1947. He was a past president of the Spokane District Dental Society and had been a member of the Washington State Board of Dental Examiners since 1975. Dr Whittaker was a fellow in the International College of Dentists and a member of many other dental organizations including the Academy of Operative Dentistry, the Pierre Fauchard Academy and Xi Psi Phi. He was active in study clubs and was mentor of Spokane's Gold Foil Study Club, which now bears his name. In 1973 the Washington Academy of General Dentistry named Dr Whittaker dentist of the year for eastern Washington.

Paul Whittaker's character and concerns were evidence of his deep religious faith. He participated in his church, community service clubs, and in the Boy Scouts and PTA. He was considerate and kind, honest and just. He is missed greatly by his wife, four children, and many friends.

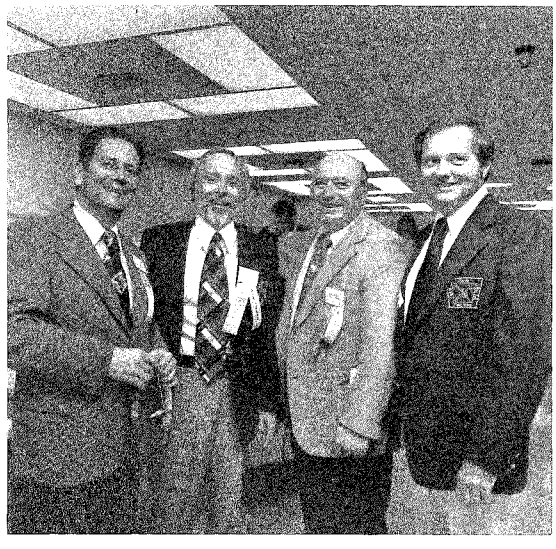


NEW OFFICERS 1978—AMERICAN ACADEMY OF GOLD FOIL OPERATORS. Left to right: *Anthony D Romano, president; Chester J Gibson, president-elect; Melvin R Lund, vice-president; David A Grainger, secretary-treasurer; Lloyd Baum, councillor; Harold E Schnepper, councillor. Not in picture: Norman C Ferguson, councillor.*

NEWS OF THE ACADEMIES

American Academy of Gold Foil Operators

The 27th annual meeting was held October 6 and 7, 1977, at the University of Florida College of Dentistry and at Disney World. Clinical operations were demonstrated during the morning of October 6. The president's reception and banquet featuring a New Orleans theme were held in the evening at the Contemporary Hotel in Disney World. The meeting concluded with a program of essays the following morning.

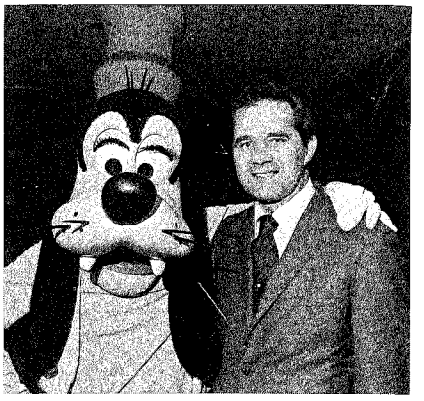


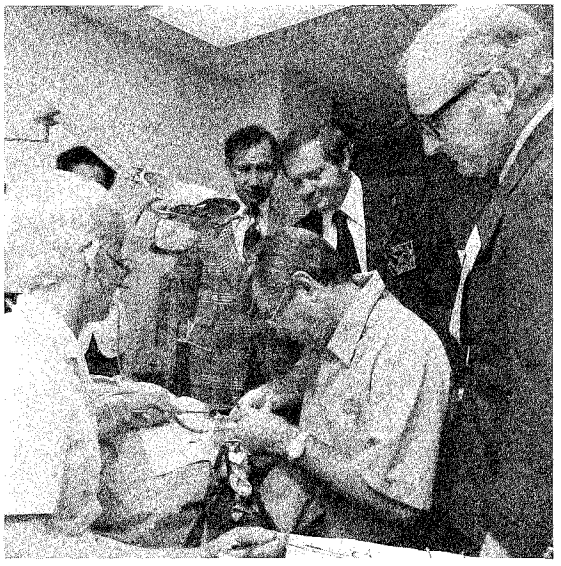
José E Medina (on left) *chats with David A Grainger, Anthony D Romano, and Hunter A Brinker.*

President-elect Chester J Gibson and his wife discuss principles of good dental care with newfound friends (too late for character on right).

Don L Allen, dean, University of Florida College of Dentistry, host for the annual meeting, and his wife with David A Grainger and his wife

Below: *Character on left discusses journal articles and policy with J Martin Anderson, managing editor.*





Above left and below: *Scenes from the operating room*

NEWS OF STUDY CLUBS

Course in Gold Foil Procedures
Seattle, Washington

The Associated Ferrier Study Clubs are planning to offer a 2-week course, September 18–29, 1978, in Seattle. This is the class participation, clinical course that is provided by the Association for its Associate members. A limited number of non-members 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 Bernard Lodge
624 6th St
New Westminster BC
Canada V3L 3C4

NOTICE OF MEETINGS

American Academy of Gold Foil Operators

Annual Meeting: October 19 and 20, 1978
Pearl Harbor
Hawaii

Academy of Operative Dentistry

Annual Meeting: February 15 and 16, 1979
Hyatt Regency Hotel
Chicago, Illinois

Wit and Wisdom

Are You Tired?

We have run across some absolutely irrefutable statistics that show exactly why you are tired. And brother, it's no wonder you're tired either! There aren't as many people actually working as you may have thought, at least not according to this survey recently completed.

The population of this country is 200 million, 84 million over 60 years of age, which leaves 116 million to do the work. People under 20 years of age total 75 million, which leaves 41 million to do the work.

Then there are 22 million who are employed by the Government, and that leaves 19 million to do the work. Four million are in the Armed Forces, which leaves 15 million to do the work. Deduct 14,800,000, the number in the State and City offices, and that leaves 200,000 to do the work. There are 188,000 in hospitals, insane asylums, etc., so that leaves 12,000 to do the work.

Now it may interest you to know that there are 11,998 people in jail, so that leaves just two people to carry the load. That's you and me—and brother, I'm getting tired of doing everything by myself!

—Anonymous

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Mail to:

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Seattle, WA 98195, USA

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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*, 3rd ed., 1966, and *Nomina Histologica*, 1975; the terms 'canine', 'premolar', and 'facial' are preferred but 'cuspid', 'bicuspid', and 'labial' and 'buccal' are acceptable. SI (Système International) units are preferred for scientific measurement but traditional units are acceptable. Proprietary names of equipment, instruments, and materials should be followed by the name and address of the source or manufacturer, in parentheses. The Editor reserves the right to make literary corrections.

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References

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