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American Academy of Gold Foil Operators

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Jack G. Seymour

President's Message

As I sit at my desk and contemplate writing this message, I think of all the distinguished men that have preceded me in this office. Beginning with Dr. Bruce Smith and continuing through to Dr. Clifford Miller, their names pass through my mind. All I can think is, what a hard act to follow!

Some of these men are no longer with us, but their achievements have left this Academy with a history and heritage second to none. It is with a great deal of humility, therefore, that I will attempt to follow in their footsteps and continue in the direction they have so ably shown us. I appreciate this honor much more than I deserve it. However, I am sure the excellent officers and Executive Council I have to help me will keep my foot out of my mouth and my loupe on straight.

I welcome Dr. Ian Hamilton who will be our new Editor of *The Journal.* To follow Dr. Jose Medina and Dr. Robert Wolcott is no mean task, but there is no doubt he will continue the excellent work these men have done and will do more than his share to keep this new combined journal at the same high standard.

The past meeting at the University of West Virginia was an outstanding success thanks to the complete, warm, wholehearted support we received from the entire school. I wish everyone in the Academy could have attended this meeting.

It is especially gratifying at this point in time to find a dean, like Dean Biddington, who supports our aims and objectives so vigorously. I am sure that not all our members can be well acquainted with what this school is teaching in clinical dentistry, particularly in gold foil — I certainly was not and was very pleasantly surprised.

By the time this edition is printed, our final interim meeting in Minneapolis will be history. Dr. Anthony Romano has arranged a splendid program, and I am certain it will be a huge success.

From now on we will have one meeting a year, preceding the annual meeting of the American Dental Association. This year it will be in Chicago on Friday, October 24. Dr. Hunter Brinker will be program chairman and Dr. Cliff Miller chairman of local arrangements. I know we can look forward to yet another excellent meeting, and I have pleasure in inviting all members to attend. Wives and guests, of course, will also be very welcome.

I want to thank the officers and members of the Academy for the honor accorded me. Please participate in Academy affairs by operating and by sending in articles for publication and suggestions for improvement; for without your participation, we will not be attaining the goals the founders of this Academy set out for us.

Dr. Jack Seymour received his dental degree from the University of Southern California. He practices in Fresno, California and is also an Associate Clinical Professor in Operative Dentistry at USC. He was formerly on the faculty of the University of California at Los Angeles in the Division of Operative Dentistry. Dr. Seymour has been a very active member of the AAGFO for a number of years. He is Director of the Jones Gold Foil Study Club, a Fellow of the International College of Dentists, and is affiliated with many other professional organizations.

Matthew F. McNulty
Pauline Mistry

Dentistry and Current Health Legislation

In recent years all aspects of the delivery of health care have been increasingly affected by legislation enacted at both the federal and state levels. Such legislation, whether it relates to the delivery of health care, the practice of health care, or the education of health professionals, has played a major role in shaping the current system of health care.

During the past two years, several major pieces of legislation were introduced or passed that are likely to have significant effects on the system of delivering health care in the United States. Although some of this legislation is aimed primarily at medical practice, it is also likely to affect the future organization, the methods of reimbursement, and the overall practice of dentistry.

Five major areas of legislation that have significant applications for the future practice of dentistry are: Health Maintenance Organization Act of 1973 (P.L. 93-222); National Health Insurance Proposals; Professional Standards Review Organizations (Sec. 249F of P.O. 92-603, the Social Security Amendments of 1972); Health Manpower Legislation; and the Keogh Benefits. The major tenets of such legislation and their anticipated effects on the practice of dentistry are discussed below.

DR. MATTHEW F. MCNULTY, Chancellor, the Medical Center, Georgetown University, concurrently holds appointments as Chairman of the Board of Trustees, Georgetown University Community Health Plan, Inc.; Chairman of the Board of Directors, University Affiliated Health Plans, Inc.; and member of the Boards of Directors of the National Biomedical Research Foundation, National League for Nursing and Group Hospitalization, Inc. Dr. McNulty has an academic rank of Professor of Community Medicine and International Health in the School of Medicine. He is an honorary member of the Omicron Kappa Upsilon National Dental Honor Society.

PAULINE MISTRY is Coordinator of Medical Center Planning at Georgetown University Medical Center. Prior to her present position, she held health research and planning positions in the King Edward Hospital Fund, London, and the Government of Ontario, Canada. Ms. Mistry has a M.Sc. degree from Loughborough University, U.K. and a M.H.A. degree from George Washington University. She is currently enrolled in the doctoral program at George Washington University majoring in Health Planning.

This paper was presented to the Academy of Operative Dentistry, November 9, 1974, Washington, D.C.

Health Maintenance Organization Act of 1973

The Health Maintenance Organization Act (P.L. 93-222) commits the federal government to limited support for a trial period of the development of Health Maintenance Organizations (HMOs). Its major purpose is to stimulate the interest of consumers and providers in the concept of the HMO and to make this form of health care available and accessible in the health care market.

HMOs bring together a comprehensive range of health care services in a single organization. They are responsible for providing their subscribers with such services as needed in return for a fixed monthly or annual payment, periodically determined and paid in advance. At the end of 1972, about seven million persons or approximately 3% of the population were enrolled in such plans.[1]

The basic health services that must be provided by HMOs receiving federal support are primarily medical, but preventive dental care for children up to age 11 is included. HMOs can, however, opt to provide supplemental health services which could include dental services.

The general concept of the HMO is not new, having been in existence for over 35 years. Some of the earlier and best known plans include: Kaiser Foundation Health Plan, Oakland, California (1942); Group Health Association, Washington, D.C. (1937); and the Health Insurance Plan of Greater New York (1947). However, it is generally true to say that the dental benefits offered by HMOs to date have not been extensive; hence very few dentists have been actively involved in such organizations.

Under the HMO Act, employers of 25 or more persons are required to offer their employees an HMO option as part of their program of health benefits, if a qualified HMO exists in the area. Consequently, as the number of HMOs increases, a larger segment of the population will be eligible for membership.

Each HMO must meet minimum standards in two areas: (1) services and (2) organization and operation. The latter includes participation of members in policy making, programs of quality assurance, continuing education, and many others.

In the immediate future there are many ways in which dental services can be offered by HMOs, including employing a dentist full-time, contracting with a dental group, or reimbursing dentists on the basis of a fee for service rendered. To date, extensive dental benefits have not been offered by HMOs because of the associated expenses, however, if demand is sufficient, HMOs may consider offering a supplemental program for increased dental benefits and employing dentists full-time.

Some of the major effects on the practice of dentistry for dentists who do join HMOs would include:

1. Dentists working more closely than ever with physicians and other health professionals.
2. An even greater use of paradental personnel, for example, dental auxiliaries and dental hygienists, in keeping with the HMO philosophy

of utilizing paraprofessionals, where appropriate, as a means of keeping down costs.

3. Increased emphasis on preventive dental services, again as a means of keeping down costs.
4. The dentist would be employed on a fixed salary and would be freed from most of the tasks of administration and management currently associated with conventional solo practice.
5. Under the HMO regulations the dentist would be subject to a program of quality control designed to evaluate both the process and outcome of the program of patient care and designed to meet the standards established pursuant to the Professional Standards Review.
6. Under the HMO regulations the dentist would be required to participate in programs of continuing education. The regulations do not, however, define this in detail.

National Health Insurance

National Health Insurance in any form will have a profound effect on the practice of dentistry. Although at the current time there is little consensus in Congress as to the form such health insurance will finally take or when it will begin, most of the original proposals offered some form of dental benefits. The following examples of the types of benefit proposed give some indication of what can be expected in the final legislation:

- ☐ THE ADMINISTRATION BILL (S. 2970, H.R. 12684) would provide routine dental services for children under 13 years-of-age;
- ☐ ULLMAN BILL (H.R.I.) would cover one examination visit per year for children up to age 12 and routine dental services for the same age group with 20% cost sharing;
- ☐ GRIFFITHS-KENNEDY BILL (S.3) would cover, in the first year of the program, dental services for children up to age 15 and, each year thereafter, extend the benefits to persons two years older up to age 25. Once eligible, the patient is covered for life. Within seven years after enactment of the legislation, a time-table for phasing in the entire population must be established.
- ☐ KENNEDY-MILLS BILL (H.R. 13870, S.3286) would provide routine dental services for children under age 13.
- ☐ FULTON-BROYHILL BILL (HR 2222, S. 444) would provide general dental care initially to be limited to children ages 2-6 and would be extended each year to children one year older up to age 17. Emergency dental services and certain oral surgery (similar to the oral surgery benefit of Medicare) would be provided at the start of the program without limitation on age.

One important question with respect to such proposals is the potential effect on low-income beneficiaries now entitled to receive dental care under Medicaid.

Since 1967, states have been required to provide early and periodic screening, diagnosis, and treatment (EPSDT) for children up to age 21 who are beneficiaries of Medicaid. In relation to dental care, the federal regula-

tions required dental services necessary for treatment of pain and infection, restoration of teeth, and maintenance of dental health. The deadline for initiating such programs was July 1969, but states have been slow to comply, and the federal government has not enforced the legislation. As of December 1973, 23 states had implemented EPSDT programs, and 21 others were in the process of implementation.

In some instances, the effects on services provided by the state is unclear, in others the effect would be a step backwards in government financing of dental care. For example, the Kennedy-Mills Bill provides no federal support for children over 21 who may now be eligible for such services under Medicaid; the Administration bill would repeal Medicaid, leaving to the states the fiscal responsibility of providing dental benefits to needy children over 13; under the Ullman and Fulton-Broyhill bills, the Medicaid benefits would continue.

No matter which bill is adopted, some of the major effects of National Health Insurance on the practice of dentistry are likely to be:

1. A greatly increased demand for children's dental services.
2. More pressure from the federal government for preventive dentistry and dental education of the public as potential means of cutting the costs of dental services.
3. Increased emphasis on control of cost and regulation of charges. A variety of methods of reimbursement are proposed in the bills, for example: the Administration bill would establish rates of reimbursement for services covered; under the Ullman bill rates of reimbursement would be based on "reasonable fees"; in the Fulton-Broyhill bill reimbursement would be based on "usual or customary charges"; under the Kennedy-Mills bill payment would be based on a fee-schedule proposed by the dental society for the geographic area and by the Social Security Administration, dentists could elect to participate or not participate; under the Kennedy-Griffiths bill, three methods of payment would be available: fee-for-service, capitation, and salary.
4. Increased emphasis on control of quality. In the Administration and and Mills-Kennedy bills, control of quality would be accomplished by amending the PSRO law to require mandatory review of all types of out-patient services. The Griffiths-Kennedy bill would establish national standards of licensure to replace the current state system, would require continuing education, and would oblige dentists to maintain records and make reports as required for purposes of dental audit. On the other hand, the Fulton-Broyhill bill prohibits federal supervision over the manner in which services are provided or the operations of providers. Several of the bills also propose federal standards for paradental personnel.
5. Probably the costs of administering a practice will increase due to the hiring of extra personnel and the additional time required to comply with all the necessary clerical and accounting tasks associated with payments from third parties. If this type of cost becomes excessive, it could provide the necessary impetus for further establishment of dental group practice.

Professional Standards Review Organizations

The authorizing legislation for the establishment of Professional Standards Review Organizations (PSROs) is Section 249F. of Public Law 92-603, the Social Security Amendments of 1972. Under this authority PSROs will be established throughout the country, with the responsibility for the review of the professional activities of physicians, practitioners of other health care, and institutional and noninstitutional providers of health care services in their geographic area.

The review of professional activities will include determining whether:

1. such services and items are or were necessary
2. the quality of such services meets standards of health care recognized by the profession
3. in the case such services are provided in a hospital or other facility for health care on an inpatient basis, such services and items could, consistent with the provision of appropriate medical care, be provided effectively on an outpatient basis or more economically in a different type of facility for inpatients.

Initially this legislation will affect primarily dentists involved in oral surgery. The law requires review only of care delivered in institutions for Medicare, Medicaid, and Maternal and Child Health beneficiaries. However, a PSRO may request at any time that DHEW allow it to extend its review to care of ambulatory patients in which case all dentists would be involved in the program. In addition (as previously discussed), National Health Insurance proposals indicate that PSROs will be the bedrock of review for assuring quality of all care delivered under a program of federal insurance.

Although dentists are not currently included on PSRO committees, Congress has made it clear that PSROs must use other health professionals to review services provided by those professions. The PSRO draft manual states that non-physician practitioners are eligible to review care provided by their peers, and should develop norms, standards, and criteria for appropriate services, and should actually perform review of peers "to the extent that it is efficient and effective."

The extent to which this legislation affects dental practice will be governed primarily by the extent to which such legislation becomes part of a program of National Health Insurance. The results of such legislation will be increased federal control over the qualitative aspects of dental practice.

Health Manpower Legislation

With the expiration of the Comprehensive Health Manpower Training Act of 1971 on June 30 of 1974, there is a great deal of speculation as to the federal government's future role in financing the education of health professionals.

Many bills relating to the financing of the education of health professionals were introduced in the 93rd Congress. The major bills introduced

were: HR 14930, introduced on behalf of the administration; HR 14721, introduced by Representative Rogers (D-Fla.); HR 14357, introduced by Representative Roy (D-Kan.); S 3585, introduced by Senator Kennedy (D-Mass.) amended by Sen. Beall (R-Md.); HR 17077, introduced by Representative Hastings (R-N.Y.).

In the interest of brevity, a comprehensive discussion of these bills will not be attempted here, however, it is interesting to note that all bills attempted to provide incentives to students, usually in the form of loan forgiveness for service in underserved area, in an attempt to correct the current problems of geographic maldistribution.

The Administration in its bill took a very firm stand against the schools of the health professions, claiming that by 1980 the nation will have a surplus of health professionals and, hence, enrollment should not be increased. In line with this philosophy, the Administration proposed the phasing out of capitation payments to schools of the health professions over the next three years.

After many months of debate in Congress, health manpower bills were passed in both the House and the Senate. Although the differences between the bills proved irreconcilable in Joint Conference Committee, similar provisions can be expected in bills to be introduced in the 94th Congress.

Both the heavily amended bill of Chairman Rogers (D-Fla.) of the House Health Sub-Committee and the bill of Senator Beall (R-Md.), which was substituted for the more radical measure of Chairman Kennedy's (D-Mass.) Senate Health Sub-Committee, require schools to increase levels of enrollment somewhat.

Both measures contained capitation money for all health professions, albeit at different levels. The House bill set capitation money for schools of dentistry, medicine, and osteopathy at $2100, compared with $2200 for dentists in the Senate version and $2500 for medicine and osteopathy. (Obviously there will be considerable debate on any capitation measure which does not give dental schools parity with schools of medicine and osteopathy.)

Unlike its House counterpart, the Senate bill required all schools of the health professions to assure that at least 25% of their students will practice in an underserved area, after graduation, in order to receive capitation money. This provision appears to be difficult to enforce, but both bills expand scholarships and loans tied to service paybacks, so the quota of 25% might be easily achieved.

Both bills offered National Health Service Corps scholarships. In both, recipients would be required to serve one year in the Corps in underserved areas for each year of aid. However, both bills also permit graduates to repay and service owed the government by private practice in an underserved area.

Both bills guaranteed to those health professionals choosing private practice in underserved areas over the Public Health Service (PHS), an income at least equal to what they would receive from the PHS, allowed them to retain any additional income from practice, and provided start-up grants of up to $25,000 to cover costs of office and equipment. The House bill offered these incentives to private practice to recipients of National Health

Service Corps scholarships; the Senate version offered one scholarship program for students selecting public service and another for those choosing private practice to repay the government for their aid while in school.

H.R. 17077, introduced in October, 1974 by Representative Hastings (R-N.Y.), Representative Nelson (R-Minn.), and Representative Heinz (R-Pa.), was designed to eliminate support by federal capitation over the next 10 years and establish instead systems of deferred tuition at schools of the health professions. Under this bill all graduates would be required to repay their alma maters all capitation money received by the schools on their behalf. This would in time establish a self-sustaining fund at each school and would eventually enable the government to phase-out capitation entirely. The idea is to force the schools to create a plan of deferred tuition reflecting true costs and to get the government and taxpayers out of the business of subsidizing the education of health professionals. (In a recent study conducted by the Institute of Medicine, the average annual cost per student of dental education was estimated to be $9,050.[2])

In conclusion, if the types of provision outlined in these bills are an indication of the type of health manpower legislation we can expect, it is immediately obvious that in return for their financial support of the education of health professionals, the government is demanding more control over the health professions. The ways in which this type of legislation could have an impact on dental practice include:

1. More young dentists practising in the currently underserved rural and inner-city areas in the years immediately after graduation in an attempt to obtain loan-forgiveness. Under the special provisions included in some of the bills related to start-up grants for practice, some of the young professionals may locate permanently in these areas.
2. The strong possibility of substantial increases in dental school fees because the reluctance of the federal government to continue supporting dental schools at the current level will result in dentists being even more indebted on graduation than at the current time. Such indebtedness could have many repercussions on dental practice, the most obvious being an increase in fees in the absence of federal controls. Another possibility is the financial inability of young dentists to establish solo practices and thus the incentive to work on a strict salary basis or join group practices.
3. An additional effect of passing on more of the costs of dental education to the student could be a reluctance of low-income and low-income minority students to choose a career in dentistry.

Keogh Benefits

At the beginning of August 1974, the House and Senate passed and sent to the President a liberalization of the Keogh Law providing tax deferrals on retirement savings of self-employed persons. The bill's Keogh plan arrangement is retroactive to July 1, 1974.

The original Keogh plans allowed the self-employed to set aside, tax free, up to 10% of their annual income with a maximum of $2,500 a year. The new legislation allows 15% of earned income not to exceed $7,500 a year.

The liberalization capped a long fight by groups of health professionals for tax treatment of the self-employed health professional that would give them the same tax incentives for saving for retirement as are now present in most pension plans of corporations.

The legislation also contains a relatively minor restriction on pension plans of corporations that would affect so-called professional corporations which have been gaining favor with many dentists in recent years because of more lenient treatment of taxes on savings for retirement. Tax deferrals will not be allowed on savings that would exceed a pension that brings in more than 75% of highest earnings over a three-year period with a maximum limit of $75,000 on potential retirement income.

Conclusion

From the foregoing discussion, it is apparent that current legislation relating to education, delivery, and practice of health care will have a significant impact on the future practice of dentistry.

If the proposed types of health manpower bill become law, young dentists, on graduation, will be more heavily indebted than is currently the norm. Some may attempt to offset their indebtedness by practicing for one to four years in a designated "shortage area" under federal direction.

In addition to change in their financial status, future graduates will probably include a much higher percentage of females and minorities. Between 1972-73 and 1973-74, the number of females enrolled in the U.S. dental schools increased by 64.4%. Although in 1973-74 only 4.3% of dental students were female, the fact that 7.2% of the freshmen students were female compared with only 1.8% of the senior students indicates a very definite trend.[3] Similarly, enrollment of minority students is increasing. In 1973-74, minority students constituted 8.5% of all dental students, but 9.7% of freshmen dental students.[4]

Through the advent of some form of National Health Insurance, more federal control on dental fees, and hence on income, can be anticipated. In addition, if continuing education, relicensure, and control of quality become mandatory, the time required to comply with such requirements could lessen the time available to the dentist for treating patients. There is, however, the possibility that third-party payments will lower the incidence of bad debts, and this, combined with the more generous tax deductions on retirement savings under the Keogh Plan, could help to offset any changes in income.

The provision of third-party payments under the form of proposed National Health Insurance, should result in an increase in the number of young and lower income patients seen.

The current federal incentives for the establishment of HMOs, combined with the increased administrative responsibilities resulting from greater federal control in all areas, could result in more dentists joining HMOs

or other forms of group practice and a movement away from the current predominant form of solo practice.

In conclusion, the future practice of dentistry will be somewhat different than today, primarily as a result of the trend towards increasing federal control over all areas of education, delivery, and practice of health care.

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2. Institute of Medicine, *Costs of Education in the Health Professions, Parts I and II*, January, 1974.
3. American Dental Association, *Annual Report on Dental Education, 1973-74*.
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Research Reviews

The aim of these reviews is the early publication of new ideas about methods of dental treatment and dental materials as well as other matters of a more general or more fundamental nature that pertain to restorative dentistry. The reviews represent an attempt to overcome the problem, faced by the clinician, that frequently a year or more elapses before new information becomes available through publication. A further object is to present summaries of information published in books and periodicals that may not be readily available to readers of this journal.

Robert E. Going

Current Research on Composite Resins

The purpose of this preview on ongoing research on composite resins is to present information on unheralded work that is presently being accomplished. For convenience I have grouped these studies into three categories, namely, biological, physical, and clinical.

Biological Studies

Pulpal Response

The response of the human pulp to two of the newer composite resins, HL-72* and Enamelite,* was investigated by Stanley, Going and Chauncey,[1] and the results were compared with the pulpal response to zinc oxide-eugenol cement. The materials were placed into Class V cavities, with and without pretreating the dentin, with 50% citric or phosphoric acid. The study showed that these resins are toxic to the pulp when they are placed in deep cavities where the dentin is unprotected. Furthermore, it was observed that when the dentin was treated with acid the intensity of the pulp response was greater, indicating increased permeability of the dentin. When the thickness of the remaining dentin (RD) was 1.0mm or less, regardless of whether the RD was entirely primary dentin or partly primary and partly reparative dentin, the proportion of pulpal abscesses

* HL-72 — Lee Pharmaceuticals, South El Monte, CA 91733
Enamelite — Lee Pharmaceuticals, South El Monte, CA 91733

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increased. It was concluded that the pulp can tolerate these restorative materials and their acid cleansing agents only if an intermediary lining of calcium hydroxide is used.

Similar results were found in the teeth of monkeys by Seelig and Doyle,[2] who used Adaptic,* Concise,* and Restodent,* as well as zinc oxide-eugenol and silicate cement. In cavities with less than 1.0mm RD, the least irritating composite resin caused as many severe reactions as did silicate cement.

Ultraviolet Light Dangers

The biological effects and potential risks associated with high intensity near ultraviolet light (UV) are currently being evaluated by Andersen and associates[3] at the Bureau of Radiological Health, and by Bannon, Webb, and Birdsell[4] at Argonne Laboratories. Andersen states in his review that recent experimental studies with cultured mammalian cells (including human cells) and bacteria, suggest that excessive levels of near UV light emitted from this electronic device may be hazardous to dentists and their patients. Although the risks to human tissue are difficult to measure, Andersen believes that the most serious long-term, or delayed, potential effect is induction of cancer, especially in certain individuals who may be unusually sensitive to near UV radiation. Bannon, *et al.*, have found the energy output of the Nuva-Lite* to be excessive and, therefore, potentially dangerous. However, they feel that relatively simple modifications of the ultraviolet unit could control these high level emissions.

Physical Studies

Wear

The wear of a number of proprietary composite resins, an unfilled resin, and a dental amalgam alloy were evaluated by Powers, Allen, and Craig[5] using cylindrical 6 x 12mm specimens abraded by silicon carbide paper. The extent of wear was determined by measuring, with a micrometer, the change in length of the specimen. The means and standard deviations obtained for the rate of wear caused by the two-body abrasion test used in this laboratory study were reported as volume loss per unit of travel. The unfilled poly (methyl methacrylate) resin, Sevriton*, was abraded 1.7 to 3.5 times more rapidly than the composite resins, whereas the abrasion rates of Spheraloy* and the composite resins were similar. Smile* and Nuva-Fil* had the highest rates of abrasion, approximately twice that of Adaptic which had the lowest rate. Prestige,* Compodent,* and

* Adaptic — Johnson & Johnson, East Windsor, NJ 08520
Concise — 3M Company, St. Paul, MN 55101
Restodent — Lee Pharmaceuticals, South El Monte, CA 91733
Nuva-Lite — L.D. Caulk Co., Milford, DE 19963
Sevriton — Amalgamated Dental Trade Distributors Ltd., London, England
Spheraloy — Kerr Sybron Corp., Romulus, MI 48174
Smile — Kerr Sybron Corp., Romulus, MI 48174
Nuva-Fil — L.D. Caulk Co., Milford, DE 19963
Prestige — Lee Pharmaceuticals, South El Monte, CA 91733
Compodent — Teledyne Dental, Palo Alto, CA 94304

Concise showed intermediate rates of abrasion. The composites containing quartz filler, namely, Adaptic, Concise, and Compodent, were found to be more resistant to two-body abrasion than were Smile and Nuva-Fil, in which part or all of the inorganic filler is lithium aluminum silicate. Prestige, with both quartz and glass inorganic fillers, showed an intermediate rate of abrasion.

An investigation of Nuva-Seal applied as a veneer over the facial surface of Class V composite resin restorations to improve esthetics and eliminate microleakage was undertaken by Kun and Pameijer.[6] The surface of the composite resin and 1½mm of adjacent enamel were etched and coated with Nuva-Seal after finishing with fine cuttlefish discs. Analysis of data obtained through a clinical examination with the explorer, through a pentration study using basic fuchsin dye, and through a scanning electron microscope examination of acetate replicas of the facial surface, revealed that in 78% of the specimens the integrity of the Nuva-Seal was not impaired after exposure to the oral environment for 12 months. Although Nuva-Seal failed, at least partly, as a glossy veneer in 22% of the specimens evaluated, in no instance was the sealant totally dislodged from the experimental area. Restorations retaining the veneer of Nuva-Seal were not as rough or stained as those with the veneer missing, and dye penetration studies of selected extracted teeth showed that an intact coating of Nuva-Seal was effective in preventing marginal leakage of dye after exposure to the oral environment for 12 months.

Using replica techniques and the scanning electron microscope to investigate the *in vivo* performance of composite resin in restored fractured incisors, Draughn and Farrington[7] found that the Nuva-Seal veneer over the Nuva-Fil restoration was worn away in less than six weeks. Their high resolution observation of the performance of Nuva-Fil and Restodent in the mouth showed further that the feathered edges of many Class IV restorations were worn away within the first few months after placement, leaving an uneven margin that remained relatively stable for more than a year. The significance of this ongoing study of 35 children with restored fractured incisors, is that extended clinical performance of composite resin restorations can be closely followed by the replica technique, thus providing definitive information about modes of clinical failure. Such information should help in the development of improved dental materials and better clinical techniques.

Marginal Adaptation

Saltzberg and associates[8] used the scanning electron microscope to examine the margins of clinically acceptable composite resin, silver amalgam, and cast gold restorations. They studied the space between the restorations and the cavity margins of all three materials and found these interface areas filled with cocci and bacilli. The authors conjectured that marginal deficiencies of this magnitude could be eliminated in the future with restorative materials that bond freely to tooth structure.

Retention

A number of studies are presently evaluating the retentive strengths of most resin systems when applied to enamel surfaces that have been etched with acid. The value of etching enamel to increase the mechanical adhesion of various systems has been well established in both laboratory and clinical studies dating back to Buonocore's work in 1955. Mitchem and Turner[9] at the University of Oregon, Draughn[10] at the University of South Carolina, Joos and Mlinar[11] at the 3M Company, and Eames[12] at Emory University, are presently collecting data on the retentive strengths of resins retained by virtue of acid etching. All four laboratory studies agree that retention is enhanced by the use of an unfilled bonding resin, like Nuva-Seal or Enamel-bond,* between the etched tooth and the composite material. Mitchem's evaluation of eight resin systems including Sevriton, Concise, Prestige, Adaptic, Restodent, Nuva-Seal/Nuva-Fil, Enamel-bond/Concise, and a prototype resin with Adaptic was done on extracted human anterior teeth. The resin was applied to facial surfaces that had been flattened and etched, and at 24 hours and 60 days they were fractured in sheer/tension with an Instron testing machine. Failure occurred in three ways, namely, at the interface between enamel and resin, within the resin itself, or in the enamel. Although the clinical significance of the differences in retentive strength cannot be stated, the newer two-resin systems should at least be equal to the Nuva-Seal/Nuva-Fil system. Transverse strength tests further indicated that one does not need to be concerned that the retaining component of the unfilled resin will weaken the retention of the composite component. Mitchem concluded that the resin-composite combination should be used rather than composite alone, despite the fact that his data do not demonstrate a statistically significant increase in retentive strength when the two-resin system is used. A clinical study of fractured incisors as restored by Fox,[13] using Adaptic with and without a bonding agent, showed no apparent differences in retention at very early 3- and 6-month examinations.

Placing grooves or locks in the proximal box of Class II preparations for improved retention of silver amalgam restorations has been a technique that has repeatedly stirred interest and raised questions for the operative dentist. A laboratory study designed by Moon, Crockett, and Shepard[14] to measure the horizontal force required to fracture Class II amalgam and composite resin restorations, showed that the force required to fracture specimens packed into cavities that had occlusal dovetails and proximal retention grooves was three to four times as great at that required to fracture specimens packed into cavities with dovetails only. Because of the inherent weakness of composite resins when used in the Class II cavity, compared to silver amalgam, proximal grooves are recommended by these researchers to resist the horizontal forces that fracture composite restorations after appreciable occlusal wear occurs.

* Enamel-bond — 3M Company, St. Paul, MN 55101

Marginal Leakage

Marginal leakage around Class V composite restorations in extracted teeth was found by Kopel and Grenoble[15] to be less if the preparations were etched and if they had butt rather than beveled cavosurface angles. The greatest leakage of brilliant red dye occurred with beveled cavosurface angles that were not etched. These authors, therefore, recommend that cavity margins receiving composite resins should always have a properly etched 90° angle to reduce marginal leakage.

Radiopaque Composite Resins

Lack of color stability after long-term water aging of radiopaque composite restorative materials prompted Mlinar and Joos[16] to investigate the integrity of the barium glasses used in these materials. Discs polished to 20mm x 1mm were placed in water or pH 5 buffer, and the barium content of the supernatant was analyzed at weekly intervals by atomic absorption analysis of the water samples. All composite resins tested showed a release of up to 1.5% of the initial barium content in six weeks at 60° C. This continuous leaching of barium caused the composite resin to lose opacity with time. These results, therefore, question the maintenance of radiopacity, physical stability, safety, and clinical usefulness of some radiopaque composite resins.

Clinical Studies

A comparative clinical study of an experimental composite resin and a commercial amalgam alloy used in Class II cavities was done by Nuckles and Fingar.[17] After one year of service no significant differences in anatomic form or marginal discoloration were found between these two restorative materials.

A longer two-year clinical study by Leinfelder and associates[18] evaluated the suitability of a series of proprietary composite resins as anterior and posterior restorative materials. They placed 899 restorations in Class I, II, III, and V cavities. Sevriton served as a control for anterior, and Velvalloy* for posterior, restorations. Compared to the unfilled Sevriton the composite resin restorations showed greater resistance to wear. However, the color match of the unfilled resin was superior to that of all composite resins, even after two years of service. The most significant finding of this study was that the wear of composite resins in Class I and II restorations was significantly greater than the wear of silver amalgam. Of the four composite resins evaluated, 53% to 90% showed substantial wear by the end of two years, compared to only 10% of the amalgams. From these results the authors concluded that Adaptic, Blendant,* Concise, and DFR* composite resins cannot be considered suitable substitutes for dental amalgam in areas of high stress concentration.

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* Velvalloy — S.S. White Dental Products, Div. Pennwalt Corp., Philadelphia, PA 19102
Blendant — Kerr Sybron Corp., Romulus, MI 48174
DFR — Lactona Corp., subsidiary, Warner-Lambert Co., Richmond, VA 23235

Summary

Based upon response to the solicitations made for this preview of ongoing research on composite resins and the papers that were presented last April at the IADR meeting, it is interesting to note that four times as much physical research was reported as was biological or clinical research. This is not to imply that biological and clinical studies are not in progress. Fairhurst[19] rècently stated that clinical and biological testing of newly developed composite formulations for the Class I and II defect is currently making progress through the efforts of several dental manufacturing companies. With his personal knowledge and involvement in the clinical testing of some of these experimental materials, Fairhurst predicts a comeback for posterior composites resins, and the defeat of past problems related to the loss of anatomical form in stress-bearing areas.

Acknowledgements

The author thanks all of the contributors who so graciously shared their research results to make this report possible.

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A. Ian Hamilton

Cavity Walls and Margins

The purpose of this report is to present some of the interesting discoveries made by Alan Boyde of the University of London, in his studies, with the scanning electron microscope, of the enamel walls and margins of cavity preparations. These studies have been published mainly in the *British Dental Journal.*

The scanning electron microscope (SEM) is one of the best instruments for examing fine details of surfaces. It is eminently suitable for this purpose because it has great depth of focus at high resolution. An example of the superb result obtainable with this instrument is illustrated in Figure 1, which is a micrograph of a cavity prepared with a diamond point.

Boyde[1-6] has used the SEM to examine the surface features of cavity walls and margins produced by various types of cutting instruments. Some of the important results of his research are summarized as follows:

Rotary Cutting Instruments

Of all the types of rotary cutting instrument, the plain tungsten-carbide fissure bur produces the smoothest surface and the best defined cavosurface angle. Furthermore, the greater the number of blades to the bur, the smoother is the resulting surface. Figure 2 shows an enamel wall — the smoothest obtained — that has been cut with a 40 blade bur.

Proximal Walls of Class II Cavity

The proximal portion of a Class II cavity presents a problem in that the cavosurface angle formed on the wall where the blades of the bur

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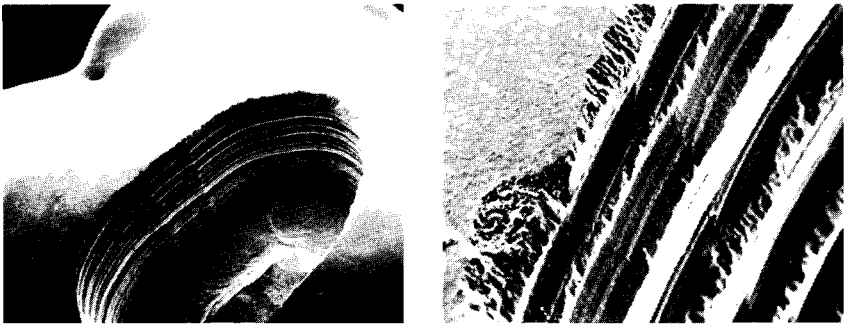
This paper was presented to the Academy of Operative Dentistry, November 9, 1974, Washington, D.C.



A B

FIGURE 1. Wall and margin of cavity cut with diamond point. Facial ⅂, A, X17; B, ×225. (By courtesy of Dr. A. Boyde and the *British Dental Journal*)

FIGURE 2. An exit margin trimmed with a tungsten-carbide bur used in the air turbine handpiece in clockwise rotation. The fine abrasive quality of the surface of this tool does not cause "chipping out." Field width 200μm. (By courtesy of Dr. A. Boyde and the *British Dental Journal*)

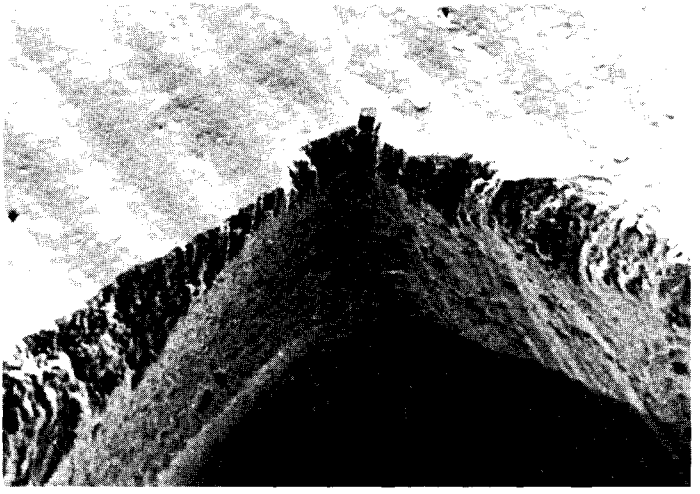


FIGURE 3. Exit corner cut with Jet 57* cutting-ended tungsten-carbide bur. Note how surface enamel chipped out on both cervical margin (*right*) and exit embrasure wall (*left*). ×140. (By courtesy of Dr. A. Boyde and the *British Dental Journal*)

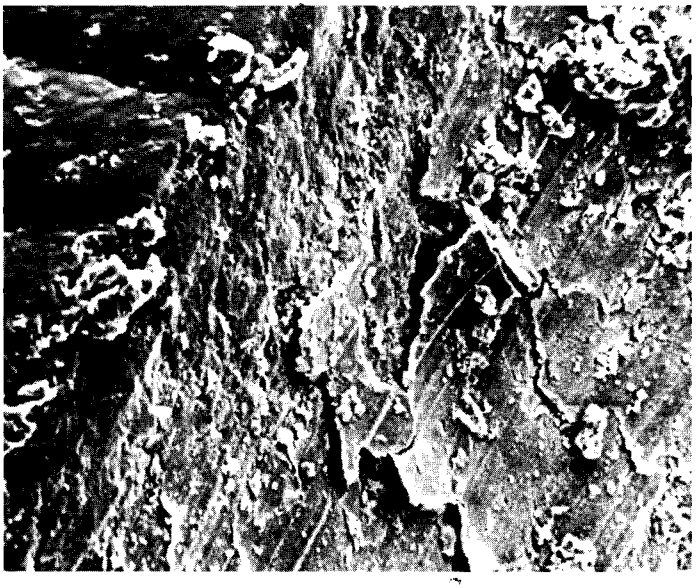
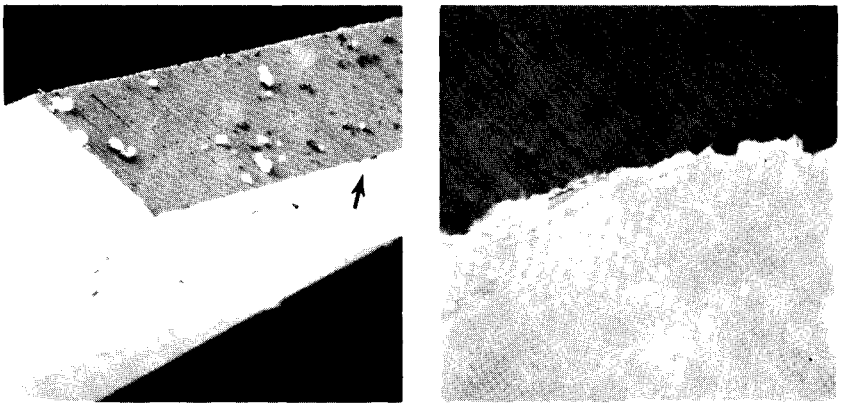


FIGURE 4. Chiselled exit side of cavity prepared with diamond point. Treatment with a sodium hypochlorite solution has resulted in the separation of the apparently smooth surface from the underlying substrate. This could be taken to indicate that this superficial layer has been "smeared" over the underlying enamel but is not firmly united with it. ×400. (By courtesy of A. Boyde and the *British Dental Journal*)

* Jet 57 — Beavers Dental Products Limited, Morrisburg, Ontario, Canada



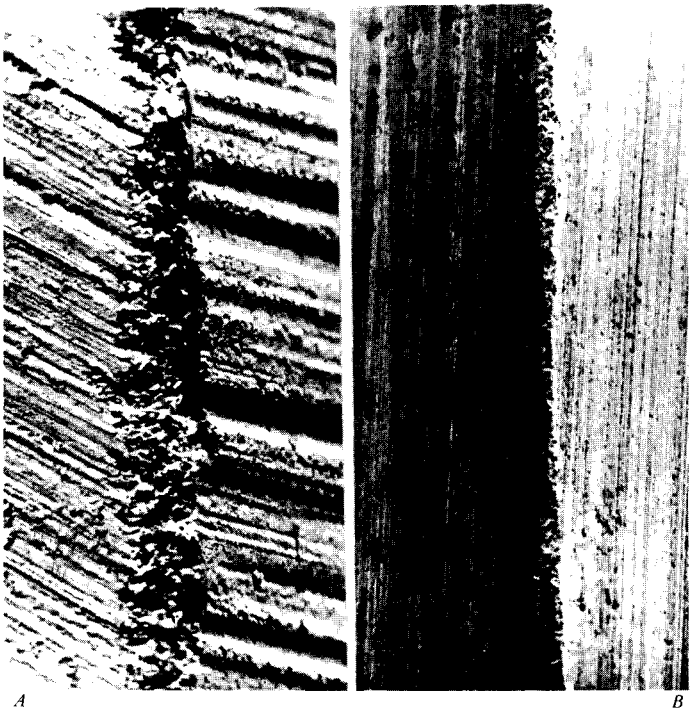
A B

FIGURE 5. *A*, Wedelstaedt chisel sharpened on a rotary stone. Grooves in surface are produced by abrasive. Cutting edge has a burr, which is more apparent in *B*, an enlargement of the region indicated by the arrow in *A*. *A* ×140; *B*, ×2500. (By courtesy of Dr. A. Boyde and the *British Dental Journal*)

rotate into the enamel surface ("entry" side) is better than the cavosurface angle on the wall where they rotate out of the cavity ("exit" side). The terms "entry" and "exit," as used here, may be exemplified by a disto-occlusal cavity in a posterior tooth on the lower left side of the arch where the "entry" side for a bur rotating clockwise would be toward the facial surface and the "exit" side toward the lingual surface. Figure 3 shows the chipping of the cavosurface margin that occurs almost routinely on the "exit" side.

Chisels

Irregularities in cavity walls and cavosurface margins can be removed by planing with a chisel. However, unless it is exceedingly sharp, the chisel tends to smear the enamel and thus produce smooth plaque-like areas. These smooth areas result from enamel melting under the pressure applied with the chisel while cutting. Smearing is greater with dull than with sharp instruments. There is a question of how securely this smeared enamel is attached to the underlying enamel. Figure 4 depicts the appearance of some of these areas after the enamel has been cleaned by brief ultrasonic treatment — four minutes — and then immersed in a 10% solution of sodium hypochlorite for three days. The edges of the smooth areas appear to have lifted from the surface. The clinical significance of smeared enamel is not presently known, though Boyde has found that smeared enamel extending beyond the cervical cavosurface margin can be fractured when a matrix band is applied to the tooth.



A B

FIGURE 6. *A*, the cutting edge of a new Ash* tungsten-carbide chisel. Field height 100μm; *B*, the cutting edge of a blade on a Jet 57 tungsten-carbide bur. Field height 100μm. (By courtesy of Dr. A. Boyde and the *British Dental Journal*)

Sharpening Chisels

The SEM shows that if a steel chisel is sharpened on a circular stone rotating so that the stone moves across the blade from the cutting edge to the distal side, a burr is formed on the cutting edge. (Figure 5)

Tungsten-carbide burs on the other hand, which are very keen, are sharpened in a direction parallel with the cutting edge rather than across it. (Figure 6) Boyd has designed a chisel tip made of tungsten-carbide that can be mounted in a latch grip handpiece. This chisel is sharpened by the manufacturer in a manner similar to that of sharpening burs; that is, parallel to the cutting edge with the chisel held rigidly by mechanical means. With this chisel, Boyde has been able to prepare cavity walls with substantially less smearing than is produced by commercially available steel or tungsten-carbide chisels.

The edge of a steel chisel, after it has been used to establish a cavity wall, is shown in Figure 7. This is the same chisel that is shown freshly sharpened in Figure 5. The edge is now blunt and enamel is embedded in the steel.

* Ash — Amalgamated Dental, London, England

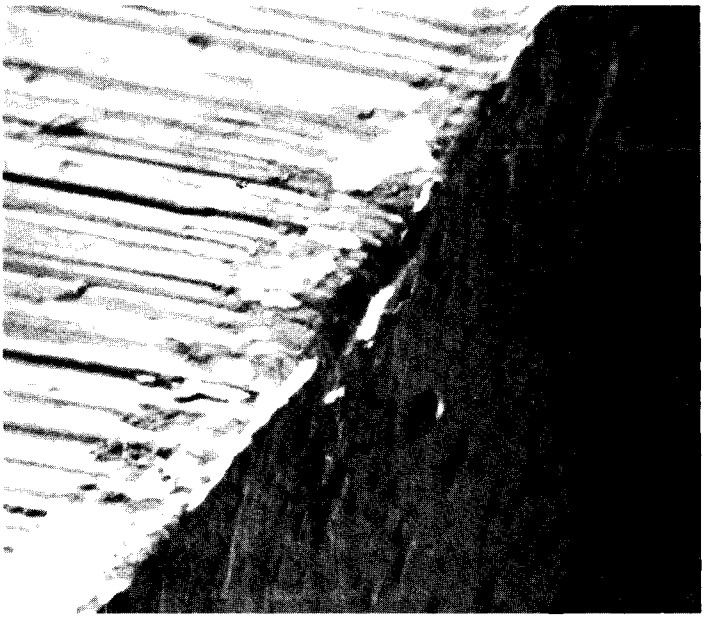


FIGURE 7. The same chisel as shown in Figure 5 after being used to establish a cavity wall. The edge is blunt and the white areas represent enamel embedded in the blade.

Most cavities prepared with burs or diamond points can be improved in certain respects by modifying the walls, at least some of them, with a chisel. This is true, for example, where flat, straight walls are required as in the incisal wall of a Class V cavity prepared for gold foil, or where there is insufficient access for a bur, as in the proximal portion of a Class II cavity with minimum extension facially and lingually. It is important, therefore, to appreciate that the chisel, to be effective, must be very sharp. Moreover, to minimize smearing of enamel, the final planing should be done with a chisel that has been freshly sharpened.

Conclusion

The interface between the enamel wall of a prepared cavity and its filling material is a vulnerable region of a restored tooth. The importance of a good cavosurface margin to the longevity of a restoration has long been recognized. Ragged cavosurface margins and margins that are rounded rather than angular, result on the one hand in poor adaptation of the restorative material, and on the other hand in thin flashings of material which are likely to fracture under stress, thus leaving openings for re-

current decay. Boyde's studies with the scanning electron microscope have revealed some unexpected features of the walls and margins of cavities and have drawn attention to the need for extra care in finishing cavo-surface margins. These studies have also led to the development of instruments that are more efficient in finishing enamel walls and have disclosed that sharpening of instruments can be improved.

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N.W. Rupp

Dental Amalgam, A Plea for Clinical Research

The fracture of the margins of dental amalgam restorations, commonly referred to as ditching, has been recognized as a problem for many years. The cause has been attributed to many factors, such as: (1) retention of excess mercury;[1,2] (2) improper preparation of cavities, including unsupported enamel prisms and crazed enamel caused by cutting instruments rotating at high speed; (3) failure to carve or finish the amalgam to the margins of the cavity; (4) corrosion of the tin-mercury (gamma 2) phase and the subsequent expansion generated by the released mercury amalgamating with the unreacted silver-tin (gamma) phase;[3] (5) delayed expansion caused by moisture during mixing and compaction of amalgams made from zinc-containing alloys;[4] and (6) creep, the movement of amalgam caused by occlusal forces.[5]

During the past few years, however, Mahler and associates have been reporting clincial research that seemingly shows a direct relationship between creep and marginal ditching.[5,6] Even though several factors may contribute to ditching, Mahler's evidence is the first indication that a single physical property may predict the long-term quality of the margins of dental amalgam restorations. Binon and others[7] have verified Mahler's observations. Restorations made from amalgam with a high value of creep are shown in Figure 1*A* and 1*B*; restorations made from amalgam with a low value of creep are shown in Figure 1*C* and 1*D*. Figures 1*A* and 1*C* show the restorations immediately after polishing. Figures 1*B* and 1*D* show them after 18 months of service.

As the result of Mahler's correlation of creep with clinical marginal ditching, and the confirmation of this finding by other investigators, a test for creep has been proposed in a revision of ADA Specification No. 1,[8] Alloy for Dental Amalgam. One of the questions remaining to be answered is the limiting value, or maximum creep, that is permissible.

Dr. N.W. Rupp is affiliated with the ADA Health Foundation Research Unit at the National Bureau of Standards in Washington, D.C. He obtained his dental degree from Ohio State University and his M.S. degree from Georgetown University. He is a member of the Naval Dental School Gold Foil Seminar, the American Academy of Gold Foil Operators, Academy of Operative Dentistry, and the International Association for Dental Research.

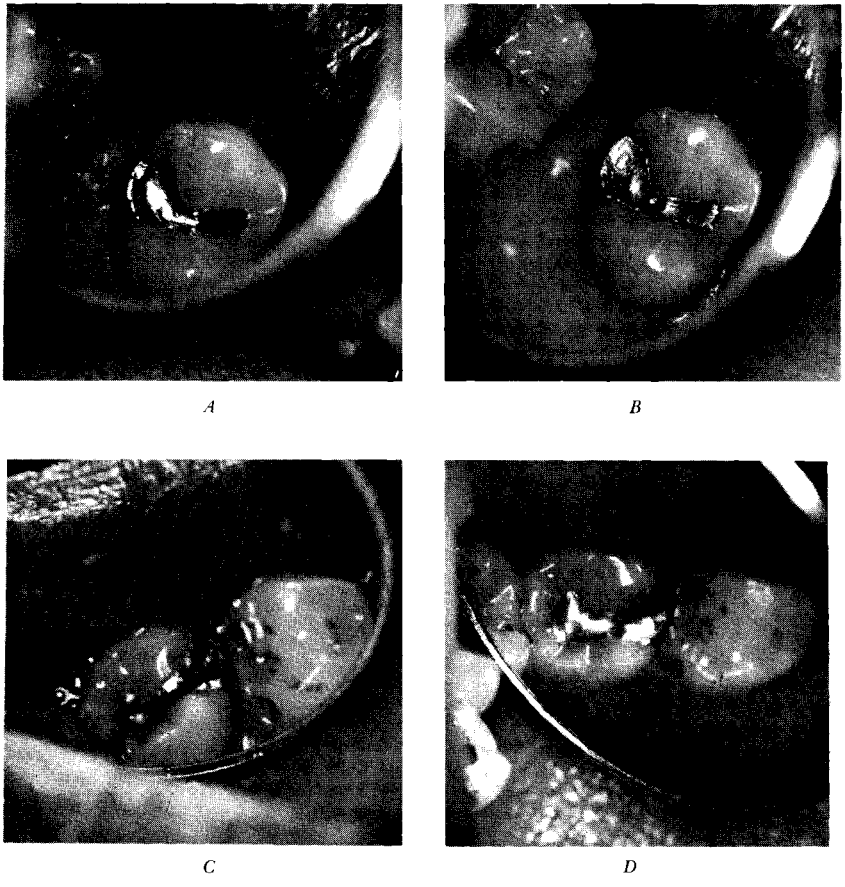

FIGURE 1. Amalgam *A* and *B* was made from a conventional silver-tin-copper-zinc alloy with a high creep value and *C* and *D* from an alloy with a low creep value. Pictures *A* and *C* were taken immediately after polishing and *B* and *D* were taken 18 months later. The two restorations are in the same mouth and were placed by one operator.

There are approximately 50 alloys currently certified as complying with the ADA Specification No. 1.[8] In the foregoing clinical reports, only a few trade brands of alloys have been tested. The values of creep for the amalgam made from these alloys differed by a factor of eight as did the severity of the marginal ditching in the clinical studies. Additional alloys with other values of creep should be tested clinically to give more data on which to decide the maximum value of creep permissible in the specification.

A problem that arises in any such clinical study is the difficulty in identifying whether the marginal ditching is related directly to creep or to

other factors, such as: amount of residual mercury, corrosion of the tin-mercury phase (gamma 2), and operator variables. A good laboratory characterization of the amalgam made from each alloy being tested clinically is therefore required. For example, the amalgam restoration shown in Figure 1*A* and 1*B* was made from a conventional lathe-cut alloy of silver-tin-copper-zinc with the tin-mercury phase present. The other restoration, shown in Figure 1*C* and 1*D*, is an amalgam with no tin-mercury phase present. Amalgams made from these alloys, along with those made from five other alloys in the clinical study at the American Dental Association Health Foundation Research Unit at the National Bureau of Standards, are being investigated for dimensional change during hardening, compressive and tensile strengths, and residual mercury, and are being examined metallographically. This characterization along with long-term clinical evaluation will provide additional experience to help determine the validity of the use of a creep test in the specification.

Summary

The long recognized weakness of marginal ditching of dental amalgam restorations has been related to the physical property of creep in clinical studies directed by Mahler.[5] As the result of his conclusions and similar observations by other investigators,[6] a recommended revision of the ADA Specification No. 1, Alloy for Dental Amalgam, includes a test for creep. This effort to strengthen the specification and limit the certification of alloys to those having acceptable marginal integrity is dependent on well-planned clinical research.

Acknowledgements

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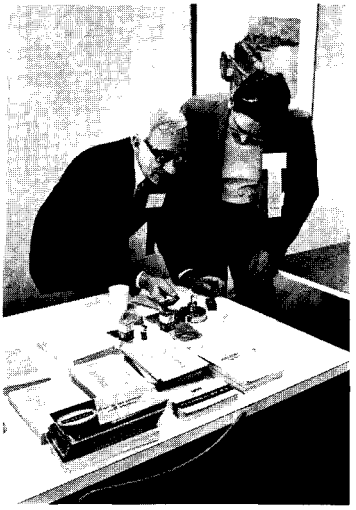
Hollenback Prize

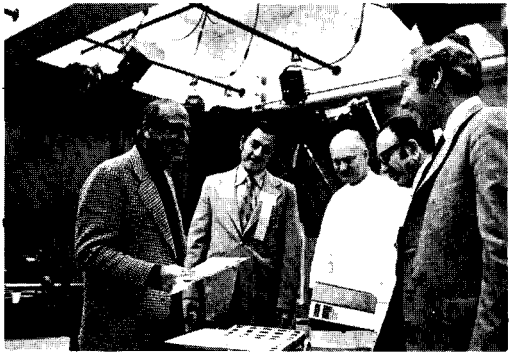
won by Robert J. Nelsen

The first Hollenback Memorial Research Prize, established by the Academy of Operative Dentistry, has been won by Robert J. Nelsen. The prize is given annually for research that has contributed substantially to the advancement of operative dentistry. Dr. Nelsen has had a distinguished career in dental research and, among his other accomplishments, has played a major part in the development of the panoramic x-ray machine and the front-surface dental mirror. However, he was selected as the winner of the Hollenback Prize mainly for his invention of a turbine-drive contra-angle handpiece.

Dr. Nelsen graduated from the University of Minnesota in 1940. After practising for a year, he enlisted in the United States Navy and was on active duty for five years. He then joined the faculty of the University of Washington as executive officer of the department of dental materials. In 1950 he became a research associate for the American Dental Association at the National Bureau of Standards where the work on the development of the turbine handpiece took place. After four years he again entered private practive and concurrently was appointed a clinical associate professor of operative dentistry at Georgetown University School of Dentistry. In 1965 he went to the National Institute of Dental Research as chief, Collaborative Research Office, and chief, Biomaterials and Special Field Projects. He is presently executive director of the American College of Dentists, a post he has held since 1969.

Scenes from the last Midwinter meeting of the Academy, held at the School of Dentistry, University of Minnesota.





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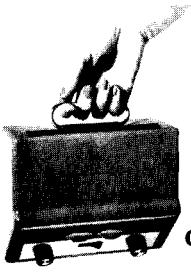
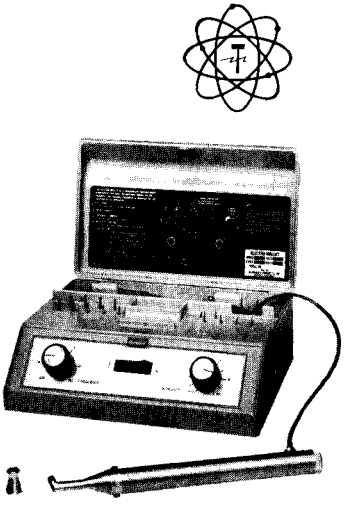


COMPACT



NEW Solid State Circuit

NEW Simplified Controls

NEW Modern, Compact Case

NEW Stop or Go Handpiece

NEW Self Cleaning Contacts

The **New Electro-Mallet** is better than ever. The Solid State Circuit is stable for malleting low or high frequencies. No warm up. No adjusting. Controls are simplified.

FOIL: The stop or go handpiece is a big improvement for placing foil. Finger pressure on any stop button keeps the handpiece from being activated. Pick up the gold and place it as desired before condensing.

AMALGAM: Adapt amalgam with the mallet stopped and condense mechanically when indicated.

SEATING: Seat inlays, crowns or bridges with our wooden insert points. Pressure with vibration causes the cement to flow evenly.

To order or obtain further information, write or call

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