THE JOURNAL

OF THE

AMERICAN ACADEMY OF GOLD FOIL OPERATORS

Vol. X April 1967 No. 1

The Journal of the American Academy of Gold Foil Operators is published biannually by the American Academy of Gold Foil Operators. The opinions expressed in this publication by individual authors do not necessarily express the views of the Academy, unless they are based upon reports adopted by the organization. The Academy reserves the right to reject, condense, revise and edit any article submitted for publication if it does not conform to the standards and objectives established by the Editorial Board. In order to be considered for publication all articles must be submitted typewritten and double spaced, at least three months prior to the date of publication. Papers presented before any of the Academy meetings will become the property of the Academy and will be published in the Journal as time and space will permit.

Printed in U.S.A. by the Premier Printing Company, Fullerton, California

Officers and Committees 1966 - 1967

Donald K. Phillips : *President*

Gerald K. Stibbs : *President-Elect*

Paul T. Dawson : *Vice-President*

H. William Gilmore : *Secretary-Treasurer*

Constitution and ByLaws Committee

J. Eugene Ziegler, *Chairman*
Robert B. Wolcott
William M. Walla, Sr.

Editorial Board

Robert B. Wolcott, *Editor*
Ralph A. Boelsche, *Business Manager*
Bruce B. Smith (1967)
Gordon J. Christensen (1968)
Clifford H. Miller (1969)

Literature and Publicity Committee

Gordon J. Christensen, *Chairman*
Arne F. Romnes
John Couglin
James P. Vernetti

Membership Committee

William J. Brennan, *Chairman*
Charles F. Bouschor (1968)
Melvin F. Rugg (1969)
Jack G. Seymour (1970)
G. Ron Heath (1971)

Necrology Committee

H. William Gilmore, *Chairman*
Carl J. Monacelli
James P. Vernetti

Nominating Committee

Floyd E. Hamstrom, *Chairman*
Ralph A. Boelsche (1968)
Jose Medina (1969)

Program Committee

Gerald D. Stibbs, *Chairman*
Lloyd Armstrong
Clifford H. Miller
Paul T. Dawson

Research Committee

Lloyd Baum, *Chairman*
George M. Hollenback
Harry Rosen
Bruce B. Smith
Harold R. Laswell

Rubber Dam Committee

Loren V. Hickey, *Chairman*
Paul A. Moore
Merryl D. Schulke
George W. Ferguson
Gene Sargent
Duane Compton

School Committee

Gerald D. Stibbs, *Chairman*
Fletcher M. Craig
Robert R. Taylor
Kenneth R. Cantwell
Ronald E. Jordan
H. William Gilmore

State Board Committee

Harry E. Weber, *Chairman*
Johan E. Wold
Lionel U. Bergeron
Walter E. L. Williamson
William Perry Powell

Study Club Committee

Fredrick A. Hohlt, *Chairman*
Jan Diepenheim
Carl J. Monacelli
D. Edward Neil
Ralph A. Boelsche

Visual Education Committee

Paul T. Dawson, *Chairman*
Clifford H. Miller
Bruce B. Smith

Executive Council

James D. Enoch
Ralph J. Werner (1967)
George A. Brass (1968)
Hunter A. Brinker (1969)
Julian J. Thomas

Academy Memberships Awarded

Active

Dr. Jim Alexander
Dr. Gordon J. Christensen
Dr. Harry Kramer
Dr. Harold Laswell
Dr. Andre Ven Tresca
Dr. James H. Brenner
Dr. Chester J. Gibson
Dr. Joseph Kanter
Dr. William A. Monroe, Jr.
Dr. Roy Boelstler
Dr. James D. Haberman
Dr. Dan H. Loving
Dr. Alfred S. Schuchard

Associate

Dr. Lloyd Armstrong
Dr. Duane E. Compton
Dr. Victor R. Cuccia
Dr. Tennyson J. Lommel
Dr. Niclaus H. Marineau
Dr. Anthony D. Romano, Jr.
Dr. Jarrold R. Schaefer
Dr. Ralph Tjarnberg
Dr. John L. Bomba
Dr. John W. Coughlin
Dr. William Hembree
Dr. Lael E. Long
Dr. John A. O'Connell
Dr. Norris L. Richmond
Dr. Charles Santangelo
Dr. William J. Thompson
Dr. Everitt V. Payne
Dr. William Roberts
Dr. Richard V. Tucker
Dr. Lloyd B. Chaisson
Dr. Frederic Custer
Dr. Richard H. Hesby
Dr. Maurice P. Lord, II
Dr. John W. Wittrock

Conservative Class II Foils

BRUCE B. SMITH, D.M.D.

Seattle, Washington

THE CLASS II GOLD FOIL RESTORATION can be one of the most beautiful, delicate and functional restorations placed in a human tooth. Its replacement of diseased structure may be so fine as to withstand the damaging effects of decades of oral service. Usually it requires a little above average skill, but with training, restorations can be made within a reasonable length of time and with a minimum of discomfort for the patient. Many sleep while the operation is being done.

To use the term "Conservative" Class II foil is almost like repeating oneself. For this restoration is conservative above all other Class II types. However, there are some specific locations where the operation may be more easily accomplished and there are some conditions under which one may work more rapidly and easily. In addition to this, there are factors which make a Class II foil the operation of choice over an inlay from purely the standpoint of conserving tooth tissue for the patient.

As Ferrier[1] has said, "Consider only the tooth as an organ not capable of regenerative processes, such as bone, muscle, and mucous membrane, that once any part of it is lost, it can never be restored in kind; and that any restoration in any material falls far short of the original."

Naturally, logic tells us that the first thing we can do is to save and conserve all possible dental tissue for the patient. And in considering incipient decay, gold foil is far superior than any inlay, for we can adapt the material to the needs of the case and not cut the tooth to suit a technique, which depends ultimately upon the withdrawal of a wax pattern from either a tooth or a die to establish the completed restoration.

Presented at the Annual Meeting of the American Academy of Gold Foil Operators in San Francisco, California on November 6, 1964.

Dr. Smith is in private practice in Seattle, Washington and is on the Operative Dentistry staff at the University of Washington. He is Chairman of the Operative Section of the American Dental Association and Director of the John Kuratli Crown and Bridge Seminar. He has been a member of the University Ferrier Gold Foil Club for 17 years. In his spare time, Dr. Smith enjoys sailboat racing.

So as prime indications we find (1) crowded or rotated teeth where an inlay would waste structure (Figs. 1 & 2); (2) bell crowned teeth for the same reason; (3) mesials of mandibular first bicuspids where no occlusal extension is required; and (4) generally speaking, mesial Class II cavities, as they are much easier for the average dentist who may not be familiar with the work.

A few general points are well to consider. On any mesial surface, a Class II foil has greater esthetic benefits. An inlay nearly always will show some gold. Often the operator has cut off the so-called "ears" of the bicuspid in preparing the inlay cavity, and amalgam used in these areas almost always shows through as a slight darkening. It is much easier to learn to condense the gold well on the mesial preparations. The angle of force is more natural and requires less use of highly offset bayonet condensers. In addition, when the work is done, it is more convenient to find any possible marginal or gingival angle deficiencies and to repair them with greater facility.

Distal Class II preparations, though slower and more awkward to fill, have one advantage in that the finishing strips and disks tend to lay in such a manner as to expedite finishing procedures. The use of the pneumatic or electromatic condensers render many of these areas highly accessible.

Condensation or compaction is the heart of all foil work – especially so in the Class II. The proximal gold should be layered and wedged toward each proximal wall. The vertical condensation should step out slightly beyond the cavosurface angle to give good wall adaptation, and the contact point should be well formed and condensed against the adjacent tooth using cohesive foil and not soft foil. A matrix has no place in this technique as lateral condensation later

Figure 1. Condensed cohesive and non-cohesive foil in a rotated second bicuspid.

Figure 2. The completed restoration showing delicacy of form and minimal necessary extension.

uses the excess gold for density and good coverage in finishing proximal and gingival margins. Minimum proximal extension often avoids great time waste. Over extension allows non-cohesive cylinders to slip out and makes it easier to add excessive amounts of foil on the lingual. Time is not only wasted in adding the excess gold, but often to a much greater extent in finishing it off.

Perhaps it is well to mention a few of the most common causes of difficulties or failures. One of the more frequent is inadequate condensation in the proximal gingival angles. This must be avoided in the placement and condensation of the three non-cohesive cylinders. These are usually two ⅛ cylinders and one ¼ cylinder of No. 4 gold. They are swept powerfully into position with the No. 13, No. 14 parallelogram condensers in both a lateral and gingival direction, then condensed vertically with the large square bayonet condenser of the Ferrier study club set. Their final height when condensed should be about ⅔rds of the height of the axial wall. This allows room for the following cohesive foil to aid in the retention of the proximal and to form the contact point.

Another common error is the use of an incorrect angle of force along the buccal occlusal walls of the preparations. To correct this tendency, a bayonet condenser or a right angle head in the pneumatic or electromatic condenser must be used. This is also frequently necessary on the mesial walls of distal cavities.

Proper layering of the gold bucco-lingually as described by Black[2] can be of great assistance in these situations. Yet from a biological standpoint, care should be exercised not to produce excessive wedging effects and pressures, as these can create hypersensitivity or even crack teeth.

These biological considerations are usually the normal ones we face in most operative procedures. There should be adequate pulpal protection from thermal shock during preparation procedures as well as suitable use of bases or medicaments to prevent post-operative complications. This may include prednisolone, calcium hydroxide and zinc oxide bases, or simply gum copal varnish. However, if sizable bases are necessary, the condensing pressures on the base should be considered. Sometimes a stronger base of zinc phosphate cement with alloy filings added is indicated. But the larger the cavity area the less the case is indicated for a foil restoration and the more an inlay or alternate procedure should be considered.

The separator can be a vicious instrument if care is not employed in its use. It should first be selected carefully to fit the case so that torsion effects are not incorporated. The jaws should be delicate and not impinge on the tissue. The screws should be free with a little "play" to avoid forceful wrench action and give more accurate control. Finally, the separator should be well stabilized with compound to avoid tissue damage and distribute pressures over four or five teeth.

CAVITY PREPARATION

With high speed a preparation can be cut very rapidly and efficiently, but the operator must have a clear picture of the preparation in mind to avoid overcutting or loss of detail. Fine cavity detail is of great importance in ensuring convenience of insertion of the gold and durability of the finished restoration.

The occlusal (Fig. 3) should be cut with a 700 series bur which has been broken and squared off to about ⅓ of its normal length. This automatically will set the proper depth and inclination of the walls. The walls must be slightly divergent in the isthmus area and at the occlusal wall distal to the proximal. This strengthens the marginal ridge. The only occlusal retention used should be gained at the expense of the buccal and lingual walls where they reach the distal. Proximal extension should be minimal to aid in supporting the

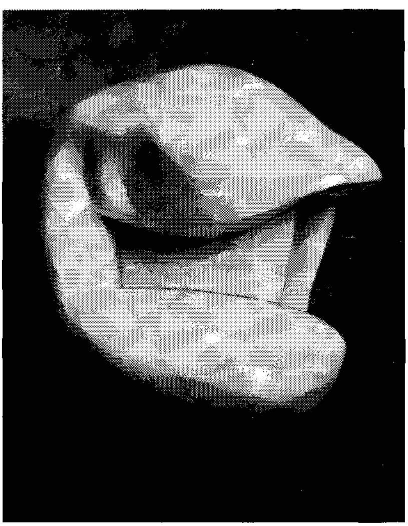


Figure 3. Occlusal view of normal Class II foil preparation. Note reverse curve on buccal to allow proper proximal boxing. Isthmus area and marginal ridge walls are slightly divergent. Retention areas are at the expense of the buccal and lingual walls toward the distal.

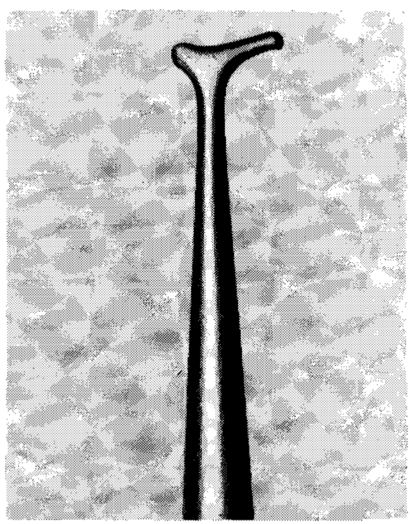


Figure 4. Extra-small burnisher with short leverage to prevent turning in the hand.

non-cohesive foil and aids in a better esthetics. No bevels should be on any walls where non-cohesive foil is employed and only the fine finish of sharp cutting instruments is necessary to plane all walls to proper outline and completion.

FINISHING

One of the greatest aids to finishing procedures is a set routine. It is more than a convenience, it is a necessity. This is the one area where many men repeat and duplicate actions, wasting time, until they eventually end up with a completed operation. The use of burs, files, gold knives and the Searl swagger* should preceed the use of graded disks. An interesting miniature burnisher is of great convenience in finishing occlusals. The small instrument has short extensions which permit the operator to exert greater burnishing force with less tendency for the instrument to twist within his grasp. Also, the small burnishing surfaces are more suited to our present delicate cavity extensions. (Fig. 4)

Finishing burs may be moistened with water to prevent "leading." They usually consist of two types: one, a squared off 700 series bur, is very fast and convenient in setting the inclined planes and central groove; the other – a round bur – may be right or left cutting, and is very helpful in trimming gold to margin, especially in the extensions. Finally, a dull number ½ round bur is excellent to accentuate and define previously established grooves.

The separator should be known by number; usually the Ferrier No. 4 is indicated for Class II foils. Occasionally, the No. 3 will be better on the angle of the arch for mesial restorations in first bicuspids. This depends upon the narrowness of the arch and the conformity of the teeth.

After all gross finishing is done, i.e., the gingival and all occlusal anatomy with the exception of the occlusal embrasure, the separator should be placed momentarily and a Gordon White saw passed through the contact area. A lightning strip and subsequent finer extra long finishing strips (Moyco) should be used with copious amounts of air. This will leave a beautifully finished and polished interproximal surface.

The strips should be manipulated with care and relieved at either buccal or lingual surface to maintain proper contact point relationship and correct embrasures at this time. The occlusal embrasure should receive special consideration. A sharp gold knife or small

* – Suter Dental Instrument Co., Chico, California

cleoid swept across the marginal ridge while the separator is in place will set up the proper angulation for the embrasure and the escape gate. It is often convenient to mount a large but extra fine cuttle fish disk in the straight screwhead (small-size) mandrel. This will by-pass the separator frame and nicely round out and highly finish the embrasure.

A step by step logical finishing routine will reward the operator with consistently excellent results with a happy, rested patient.

An ideal Class II from the standpoint of ease of operation is the mesial of the lower first bicuspid. (Fig. 5) Because it occludes with the upper cuspid only, there is no stress on the occlusal surface and no occlusal extension is necessary. Both buccal and lingual proximal walls make acute angles with the gingival due to the shape of the adjacent mandibular cuspid. The interior has accentuated axial line angles to help retention. An excellent instrument for this delicate feature is the special gingival margin trimmer No. 28° and No. 29°.* These were designed by C. T. Fleetwood and are also of great convenience in lingual approach Class III foils. (Fig. 6)

Usually only three 1/16th non-cohesive gold cylinders are placed at the gingival. The cohesive gold placement is delicate and wedging should be carefully accomplished to ensure good wall adaptation.

* – Suter Dental Instrument Co., Chico, California

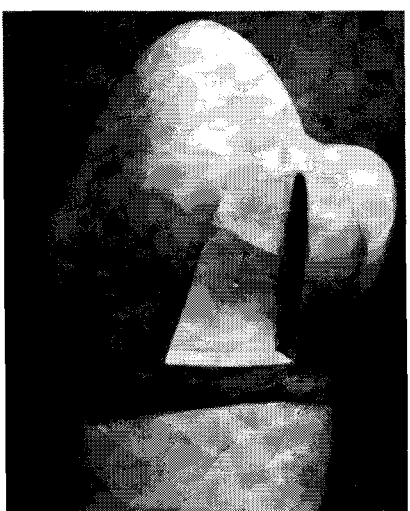


Figure 5. Cavity preparation for the mesial of the mandibular first bicuspid. No occlusal step.

Figure 6. Instrument No. 28°, the extra-small gingival margin trimmer, compared with a normal size instrument.

Finishing procedures are minimal and the operator can easily see and check his work.

The result is a delicate, beautiful and inconspicuous Class II restoration.

To cut across the large and solid transverse ridge would be a waste, both of time and tooth structure, for this tooth is much like an overgrown cuspid. A central groove is almost never present. If a groove is present, it is nearly always in the distal portion of the occlusal. (Fig. 7) In addition, if an occlusal extension were made, the great size of the buccal cusp would tend to augment thermal shock because of gold being closer to the extension of the pulp.

One of the first questions asked by men tempted to try Class II foil work is, "How much time should this operation take?" Naturally, the correct answer is, "Enough time to do the case at hand properly." However, to quote averages which may be helpful, two to two and a half hours should be allowed in the beginning. Later, an hour and a half to two hours should be adequate. Ideal cases have been done in an hour or even 45 minutes by highly skilled men, and the most remarkable time of 40 minutes, including anaesthetic administration, has been witnessed.

To return to normal considerations however, it's safe to say that the time consumed to create a beautiful Class II foil is nearly always less than the time and effort required to produce and cement a Class II inlay. The operator should not think in terms of speed,

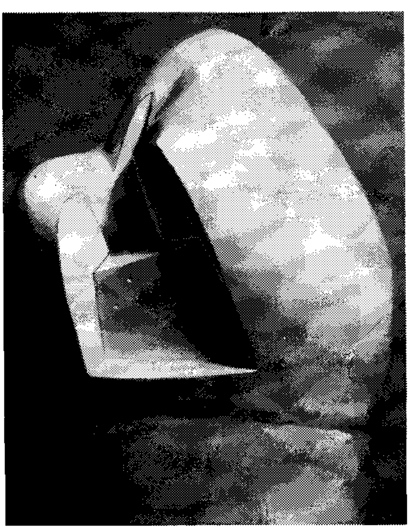


Figure 7. Cavity preparation for the distal of the mandibular first bicuspid. Occlusal step is sloped to avoid the large pulp horn.

but in terms of excellence, efficiency and service.

Lastly, let us consider contra-indications. It is proper here to quote the Latin legal phrase, *res ipsa loquitur*, the thing speaks for itself. For professional experience, training and judgment are almost perfect guides to the average man. A tooth without proper gingival support would certainly not be a likely candidate to receive condenser blows or even give good gold condensation. Large cavities imposing undue stress on the patient or the tooth are questionable to use. Devital teeth, or those with impaired circulatory protection, should be avoided if possible. Then, once in a great while, the unusual patient will appear who is psychologically unsuited to stand the malleting or condensing blows. Fortunately, the usual patient, on the other hand, seems to actually enjoy his brief period of relaxation while the foil is placed.

In conclusion, it is hoped that some ideas and aids toward operational procedures will have been found here. If so, the author may have partially repaid his debt for some of the help and assistance gained from predecessors.

References

1. Ferrier, W. I.: *Gold Foil Operations*, University of Washington Press, Seattle, 1959.

2. Black, G. V.: *Operative Dentistry*, Volume II, Medico Dental Publishing Co., Chicago, Illinois, 1908, Pgs. 271-2.

A Comparison of The Marginal Penetration of Direct Filling Golds Using Ca 45

ROBERT P. THYE, D.M.D.
Los Angeles, California

IN RECENT YEARS many new preparations of direct filling golds have become available to the dentist. Despite their varied nature and characteristics following manufacture, these golds should create restorations which are marked by their quality of hardness, density and marginal integrity. Clinically, these golds are handled in many different ways. Some are placed with mechanical condensation, some with hand malleting force and some with hand pressure condensation. All methods appear effective. The purpose of this study was to compare the marginal sealing qualities of various direct golds placed with mechanical and hand pressure condensation.

Twenty-five years ago Grossman studied marginal adaptation of temporary materials using dyes.[1] Since that time various methods have been used to assess marginal integrity. These tests have included the use of various dyes, bacteria and isotopes to measure marginal penetration of various restorative materials placed in glass, metal and extracted teeth.[2-12] Swartz and Phillips, et. al.,[9,10] found that the comparatively favorable reliability of Ca^{45} in either in vivo or in vitro studies makes it a useful tool for this study.

PROCEDURE

Restorations were placed in freshly extracted canines and premolars. The preparations were placed on the labial or buccal surfaces of these teeth and at least 2mm above the cervical line. The types of gold used were the following: powdered gold wrapped in gold foil,* mat gold alloy, 24 carat gold and cohesive gold foil. The alloyed

* — Goldent. Morgan Hastings Co., Philadelphia.

This study was supported in part by a grant (USPHS 5-S01-FR-5304).
Dr. Thye was born and raised in Portland, Oregon. He attended Oregon State University where he received his B.S. degree, then on to the University of Oregon Dental School for his D.M.D. degree in 1962. Dr. Thye has been on the Operative Dentistry staff at UCLA School of Dentistry since 1965. Prior to this, he was an instructor at the University of Oregon and was engaged in private practice in Portland. In his spare time Dr. Thye enjoys golf.

mat gold was composed of 97% 24 carat gold, 1% platinum, 1% palladium and 1% silver.** The direct filling golds were each condensed with manual, pneumatic and electromallet methods. All hand pressure condensation was done between 8-10 pounds of pressure using a 0.75mm condensing instrument. The hand pressure was measured by a manudynamometer. The pellets of powdered and mat gold were adapted to the cavity prior to condensation in an attempt to prevent bridging. In hand condensation, rocking motions of the condenser points were employed to achieve maximum condensation. Electromallet condensation was done at medium frequency and an intensity of 6. The pneumatic mallet was set at medium frequency and intensity. The finish of the restorations was accomplished by removal of gross excess with a stone, and burnishing the surface with a finishing instrument while shaping with disks. A cleoid-discoid was also used to finish the gold to margin. The surface was then polished with fine pumice until a smooth surface was obtained.

Calcium^{45} was a very convenient isotope for use in this study because it is a low energy beta emitter and it does not readily penetrate enamel. The Ca^{45} was in the form of $Ca\ Cl_2$. The concentration of this solution was 0.1 millicurie per milliliter. Its pH had been adjusted to 5.5 with 0.1 N sodium hydroxide to reduce the possibility of decalcification of tooth structure.

The roots and occlusal areas of the teeth were coated with a clear lacquer. While the lacquer was tacky, tin foil was adapted over these areas. Then a second coat of lacquer was carefully applied to seal the margins of the tin foil. The isolation must be done carefully to protect the exposed dentin and root canals from the isotope. After immersion in the isotope for 2 hours, the specimens were rinsed and scrubbed with a strong detergent and water. The teeth were then longitudinally sectioned on a 400 mesh carborundum wheel. The surface of the wheel was dressed and cleansed between each specimen to avoid cross contamination. The pulp and debris were removed from the chamber and root canals of each sectioned tooth. The specimens were scrubbed with detergent and dried before placement on the film. Ultra-fast dental x-ray film was used. The tooth section was placed directly in contact with the film for 17 hours. More detailed descriptions of the technique have been presented by Phillips and co-workers.[9-10]

The radioautographs were then developed and evaluated. The evaluation was done by grading the radioautographs on a four-digit basis. No marginal penetration of isotope was graded as zero; pene-

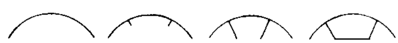
** – Special product. Williams Gold Refining Co., Buffalo.

tration to the depth of about 0.5mm was graded one; penetration to the pulpal floor was graded as two; and penetration around the restoration was given a value of three. A schematic representation of the above grading system may be seen in Table 1. A minimum of eight samples of each material and method were evaluated. Since powdered gold gave readings that ranged from slight to extreme penetration, more samples were run.

RESULTS

As may be observed in Table 1, the greatest marginal penetration of isotope occurred when each type of gold was hand condensed. Mechanical condensation of each gold reduced its marginal permeability. When mechanical condensation was done, the results of this study do not indicate any type gold sealed better than another. The mechanically condensed alloyed mat gold may be more impervious, but not to any great degree. No difference was noted between pneumatic

PENETRATIONS



MATERIALS *Method*	no 0	slight 1	moderate 2	extreme 3	total no. samples
1. POWDERED GOLD *Hand Condensed*	—	1	10	2	(13)
2. POWDERED GOLD *Mechanically Condensed*	1	8	1	—	(10)
3. 24 K MAT GOLD *Hand Condensed*	—	1	7	—	(8)
4. 24 K MAT GOLD *Mechanically Condensed*	1	7	—	—	(8)
5. ALLOYED MAT GOLD *Hand Condensed*	—	—	2	6	(8)
6. ALLOYED MAT GOLD *Mechanically Condensed*	3	5	—	—	(8)
7. 24 K GOLD FOIL *(over mat base) Mechanically Condensed*	2	6	—	—	(8)

Table 1 — Comparison of marginal penetration of various direct gold materials using hand pressure and mechanical condensation. Schematic drawings above each column illustrate evaluation system used.

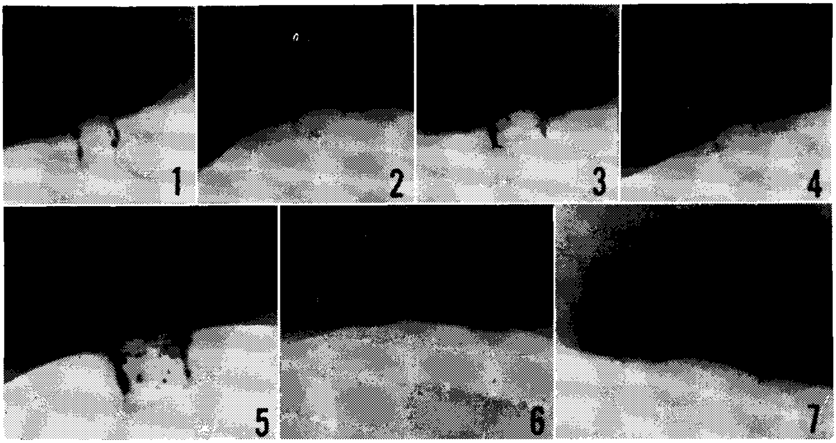


Figure 1 — Radioautograph of powdered gold restoration using hand pressure condensation.

Figure 2 — Radioautograph of powdered gold using mechanical condensation.

Figure 3 — Radioautograph of 24 carat mat gold restoration using hand pressure condensation.

Figure 4 — Radioautograph of 24 carat mat gold using mechanical condensation.

Figure 5 — Radioautograph of alloyed mat gold with hand pressure condensation.

Figure 6 — Radioautograph of alloyed mat gold with mechanical condensation.

Figure 7 — Radioautograph of 24 carat cohesive foil over mat base using mechanical condensation.

and electromallet methods of condensation. A representative radioautograph of each restoration and method in Table 1 may be seen in Figures 1-7.

DISCUSSION AND CONCLUSIONS

All direct gold restorations were exposed to room temperature isotope. The investigations by Nelson, Wolcott and Paffenbarger[13] and later work by Parris and others[11-12] have proven temperature changes which are normal extremes in the oral cavity induce an opening and closing of the restoration-tooth interface due to differentials in coefficients of expansion. Since all restorations used in this study were gold, temperature changes were not evaluated.

The choice of direct gold for a given restoration will have to be based on clinical considerations and physical properties other than marginal penetration. The convenience and surface hardness necessary will probably be more important in selecting materials since all golds tested in this study were similar in marginal integrity when mechanically condensed. Although mat gold alloy appeared to seal best, it was very brittle and difficult to manipulate. Therefore, it might be used in Class I or V restorations, but its use in proximal areas is not recommended. Based on the results of this study it would seem advisable to mechanically condense at least the surface and marginal areas of all direct gold restorations.

References

1. Grossman, L. I., A Study of Temporary Fillings as Hemetic Sealing Agents. *J. of Dental Research*, 18:67, Feb., 1939.
2. Armstrong, W. D., and Simon, W. J., Penetration of Radiocalcium at the Margins of Filling Materials: A Preliminary Report. *JADA*, 43:684, Dec., 1951.
3. Buchanan, G. A., Resistance of Self-Curing Acrylic Resin to the Passage Dye Between Filling and Cavity Wall. *J. of Canadian Dental Association*, 17:131, March, 1951.
4. Sausen, R. E., Armstrong, W. D., and Simon, W. J., Penetration of Radiocalcium at Margins of Acrylic Restorations Made by Compression and Noncompression Techniques. *JADA*, 47:3636, Dec., 1953.
5. Massler, M., and Ostrowsky, A., Sealing Qualities of Various Filling Materials. *J. of Dentistry for Children*, 21:288, 1954.
6. Crawford, W. H., and Larson, J. H., Fluid Penetration Between Fillings and Teeth Using Ca^{45}. *J. of Dental Research*, 35:518, August, 1956.
7. Taylor, J. B., and others. Microleakage of Gold Foil Fillings. Abstract, *J. of Dental Research*, 38:749, July-Aug., 1959.
8. Going, R. E, Massler, M., and Dute, H. L., Marginal Penetrations of Dental Restorations as Studies by Crystal Violet Dye and I^{131}. *JADA*, 61:285, Sept., 1960.
9. Swartz, M. L., and Phillips, R. W., In Vitro Studies on the Marginal Leakage of Restorative Materials. *JADA*, 62:141, Feb., 1961.
10. Phillips, R. W., and others, Adaptation of Restorations In Vivo As Assessed by Ca^{45}. *JADA*, 62:9, Jan., 1961.
11. Parris, L., and Kapsimalis, P., The Effect of Temperature Change on the Sealing Properties of Temporary Filling Materials, Part I. *OS, OM, and OP*, 13:982, Aug., 1960.
12. Parris, L., and others, The Effect of Temperature Change on the Sealing Properties of Temporary Filling Materials, Part II. *OS, OM, and OP*, 17:771, June, 1964.
13. Nelsen, R. J., Wolcott, R. B., and Paffenbarger, G. C., Fluid Exchange at the Margins of Dental Restorations. *JADA*, 44:288-295, March, 1952

The Class III Compacted Gold Restoration

CHARLES M. STEBNER, D.D.S.

Laramie, Wyoming

FOR MORE THAN TEN YEARS the writer has been practicing techniques and presenting ideas for compacted gold restorations which are not conventional. Many of these procedures are contrary to the concepts and statements often presented by various individuals and groups and they are not in general accord with teachings presented in the various colleges of dentistry. Nevertheless, in practical application of clinical and laboratory experimentation, it seems that rather unconventional procedures may be desirable. In the final analysis of any technique, the result is the prime factor to be considered, and it may be that certain empirical teachings in this field are based on mistaken ideas which can be disproven by demonstration and clinical experimentation.

It has been demonstrated that uniformly smooth and very cohesive surfaces can be produced by condenser points that have little or no serrations and that perhaps it is desirable and efficient to discourage the use of the deeply serrated condenser points. Also, there is justification for criticism of the conventional Class III cavity design that has been generally taught and accepted in the various schools of dentistry and also accepted as a standard on many state board examinations. It is possible that we have handicapped the student of operative dentistry with retention areas that are too meager. Rather, with more generous retention, restorations could be made more simple and practical, and thereby the greater use of this excellent material would be encouraged.

THEORY AND PRACTICE IN FOIL CONDENSATION

The line of force should generally be applied at an angle toward the surrounding cavity walls. With smoother faced condenser surfaces the operator may take advantage of a skidding motion in surface

---

Dr. Stebner was born and raised in Wyoming. He attended college at the University of Denver and the School of Dentistry at Creighton University. He is a life member of the Woodbury Study Club, Past President of the American Academy of Gold Foil Operators and the Wyoming State Dental Association. He is a Fellow of the American College of Dentists and International College of Dentists and a member of the Academy of Restorative Dentistry. Dr. Stebner enjoys hunting, fishing and golf.

to be covered. This motion is aided by the action of the electromallet* or the pneumatic instrument.** This phenomenon is produced by the burnishing and sweeping motion permitted with the smoother condenser point. Such uniform stepping cannot be as efficiently accomplished with the up and down motion necessary with the factory serrated instrument. A reasonable example might be the difficulty presented in an ironing procedure if one were to use a waffle iron in comparison with the conventional smooth-faced laundry iron.

The purpose to be accomplished in foil condensation is to achieve true cohesion, rather than adhesion, in which the molecules of base mass are locked through molecular contact and force to the molecules of the newer addition. It is obvious that a greater mass of molecules are more readily available on the smooth surface. Yet, demonstrations of this have surprised many who observe it, especially students and graduates who were taught to apply new gold to very rough surfaces. They can say, "You cannot do it against a burnished surface because the next piece will not cohere." Or, "If the serrations of the condenser are worn, cohesion will be lost because of a smoother surface." These empirical statements have been passed on from instructor to student for several generations in dental education. Such statements cannot be substantiated by actual clinical or laboratory tests. When we lose cohesion, it is not because the surface is too smooth from a burnishing process, but rather it is because impurities and contamination have entered the picture. Precise overlapping or stepping is most difficult to achieve, and when this is not perfectly accomplished, some areas receive unnecessary malleting, while others receive little or no direct condensing pressure. An ironing approach is more efficient and the resulting foil appears denser and requires approximately 30% less malleting time in the larger foils.

Perhaps the following question is in order: Why does a new pellet of foil cohere to a mass which is already formed? It has been fallaciously assumed that a deeply serrated instrument face provides a mountain and valley surface through which cohesion is gained, but this to a greater degree is mechanical interlocking. Such unions may later separate; they may also show unnecessary entrapment of air that results in pit formation. Rather, we should be aware that it is more desirable to produce a molecular cold-welding process.

Cohesion has been defined as . . . "That force by which molecules of the same kind, or of the same body, are held together so that the body resists being pulled to pieces." When pure gold, absolutely clean, sticks to pure gold, there is molecular unity of the entire mass.

* – McShirley Manufacturing Co., Glendale, California.
** – Cleve-Dent Mfg. Co., Cleveland, Ohio.

LAMINATED FOIL

Dr. C. E. Woodbury and others taught the use of non-cohesive cylinders in which a No. 4 sheet of foil was folded upon itself to form one to three millimeter width strips. These strips were of about twenty-four thicknesses and were rolled into cylinders which were finally introduced into the proximal areas of Class II cavities.

This unannealed form (Figs. 1 & 2) is non-cohesive in nature and the various thicknesses of the sheet foil can be wedged and later covered with cohesive foil. The many surfaces are contaminated by the atmosphere, humidity and gases, and provide a coating which permits them to slide upon one another and creep into tight approximation with one another and the surrounding walls of the cavity.

The author worked with some of these cylinders in June 1964 and wondered what would happen if the twenty-four thicknesses were heated to drive off the gases and contamination and then firmly pressed together with a flat instrument or condenser. The result proved, as expected, that a solid, welded mass could be easily achieved. It was then evident that these strips could be cut into triangles, forming thin packages of foil of considerable weight and volume so shaped as to be introduced conveniently into most cavity preparations.

Figure 1 (above) — A sheet of No. 4 or No. 6 non-cohesive gold foil is placed on a clean towel. A knife-edge spatula is placed on the foil and the cloth raised to cause the gold to fold upon itself. This process is repeated until a long strip is developed which is about 3mm. wide and is composed of 16 or 24 thicknesses.

Figure 2 (right) — Woodbury suggested the long strip (top) for use in the Class II cavity. This form may be cut into various forms of laminated pellets after the annealing process.

The gold is annealed by holding the package in a thin, finely pointed cotton tweezer as it is carried through the alcohol flame in the conventional annealing technique. Hollenback[1] has indicated that the clean and clear open denatured alcohol flame produces superior heat treatment results as compared to other methods of annealing.

These very thin packages of laminated foil are more easily introduced into crowded and narrow areas where there has been noticeable difficulty in placing the round ball-like pellets. It is especially advantageous to use these packages to cover the labial surface and margin in the inconspicuous cavity, as advised by True[2] and Jeffery,[3] It seems desirable to use this material in combination with other types of pure gold, such as gold foil pellets and mat gold.

After working with this material for more than a year, with encouraging clinical results, it was noted that Hollenback[4] had reported some experimentation with this form of pure gold in the laboratory. He called it "Laminated Foil," which seems to be a good descriptive term. He reported that the material had interesting and rather superior physical properties and noted that, "Restorations accomplished with this material showed a high degree of density complete with absence of pits and are capable of taking and maintaining a high degree of polish." The author's clinical experience suggests very tight margins with surprisingly close adaptation to the enamel, and it is apparent that it accomplishes good protection to frail enamel and nicely covers margins and angles which present difficult access.

TECHNIQUE FOR THE CLASS III RESTORATION

Generally, the gold foil restoration of the past has been made entirely of the commercially prepared cohesive gold foil pellets. Today there are more than a half-dozen varieties of pure gold filling materials. Some of these are rather new and experimental. These various forms may be used singly or in various combinations. In the Class II restoration it seems practical and efficient to start with a piece of mat, or crystalline, gold and then alternate with various combinations of hand rolled pellets and triangles of laminated foil. All of these are annealed before insertion into the cavity.

CAVITY PREPARATION

It has been reported by Nelson, Wolcott and Paffenbarger[5] that the margins of all restorations have a tendency to percolate fluids. An obvious opening at various margins has occasionally been noted in foils placed by the author, although many have served for more than twenty years. It is sometimes necessary to remove and replace some of these restorations, and their examination suggests two general weaknesses which are probably responsible for the failure: namely, minimum retention and inadequate bevel of the margin. It is not necessary to subject the restoration to either of these weaknesses (Fig. 3).

With thirty-five years of experience, one learns to predict failure and success. The limited resistance and retention form traditionally advocated in nearly all schools of dentistry is challenged by the author as cause for many of the Class III failures (Fig. 4).

Displacement caused by heavy abrasion on the lingual wall of maxillary Class III restorations (and some of the percolation) can be reduced by more generous retention areas. Furthermore, the challenge to place gold into cavities with traditional retention can be frustrating to clinician and students alike.

The spiral drill, often used for various pin techniques, also seems to serve foil retention areas better than the small round or inverted cone burs. Markley[6] has repeatedly advised the use of this idea to build more secure amalgams and Courtade[7] and others suggest the same retention to make castings more secure. Why should anterior foils subject to great lingual stress serve without similar dentin retain-

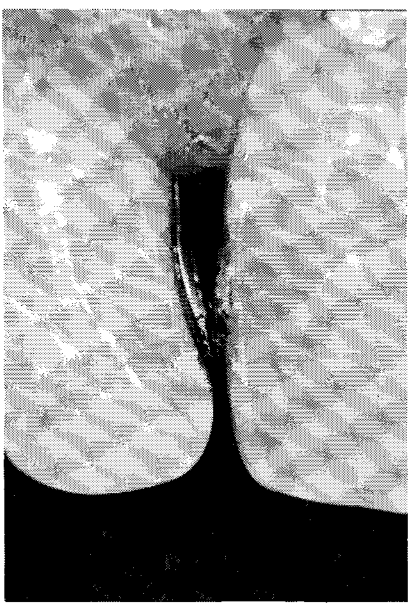


Figure 3 — The foil in the mesial of the lateral incisor failed after six years because of inadequate retention to resist lingual abrasion. X-ray showed greater strength in the cavity preparation for the foil in the distal of the central incisor.

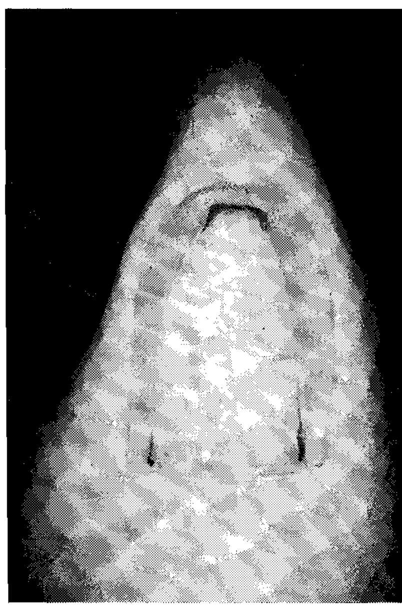


Figure 4 — This is a characteristic Class III preparation suggested in most schools. Retention is usually made in the gingival area with the smallest round or inverted cone bur and sharpened slightly with hand instruments.

ment? After the use of the spiral drill, line angles are added to the area with the conventional hand cutting instruments (Fig. 5).

Another suggested change is the longer bevel at all cavosurface margins. Foil, especially the laminated variety, is a material well suited to cover and protect fragile enamel. The generous bevels seem to reduce marginal percolation noted in butt joints because they are a hedge against opening of margins created in part by the factor of coefficient of expansion.[8] As a further protection against marginal ingress of materials about amalgam restorations, the consistent use of a cavity varnish is recommended.[9,10] However, these varnishes have not as yet been justified for use around compacted gold restorations, except as lining beneath them.

The convex axial wall of the typical Class III dental school cavity preparation is unrealistic. Nearly all pulpal walls become concave with the removal of caries or other fillings that are being replaced. It is difficult to build foil over a convex surface; whereas the material enters into the retention areas with more stability from a concave axial wall. The less desirable preparation suggests the third retention area at the extreme incisal area (Fig. 6). Rather, it is de-

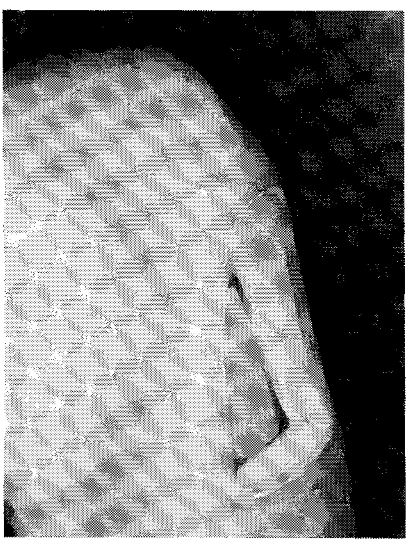


Figure 5 — A new design with a concave axial wall and more adequate gingival retention using the spiral drill. The retention is placed under the labial wall (or lingual) where there is more dentine available than at the incisal. This reduces the tendency for fractured angles.

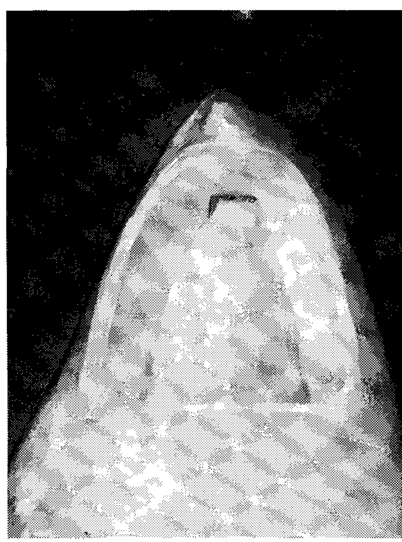


Figure 6 — The conventional incisal retention and the convex axial wall are less desirable.

sirable to form a labio-incisal or linguo-incisal retention slightly away from the incisal extremity (Fig. 7). Too often the removal of the small remaining triangle of dentine that supports the incisal angle, and even the cutting away of some of the enamel, will result in ultimate fracture of the angle to produce a Class IV cavity. This is often the case as the tooth wears at the incisal. Care in the preparation of this retention will prevent many of these broken angles.

PLACEMENT OF THE GOLD

Manipulation is simplified and the entire operation requires less time if a piece of mat, crystalline gold is placed to cover the entire axial wall of the Class III cavity (Fig. 8). This is similar to the approach suggested by Koser and Ingraham[11] for the Class V operation. This piece of gold is loosely tucked into the retention areas with hand instruments. Then two or three conventional foil pellets are condensed, forcing gold into each of the three retention areas separately (Fig. 9). This approach eliminates the need of holding instruments in most cases, and it is desirable to free one of the operator's hands, particularly with the lingual approach procedure, because one hand is needed for the mirror. There is less tendency for the mass to be loosened as the line of force is changed during the condensing process.

Figure 7 — Ample retention is made at each gingival area with the spiral drill. This is refined along the gingival and avial with angle-forming instruments.

Figure 8 — A single piece of triangular mat foil is annealed and placed against the entire axial wall. It is loosely tucked into the retention areas with larger hand condensers.

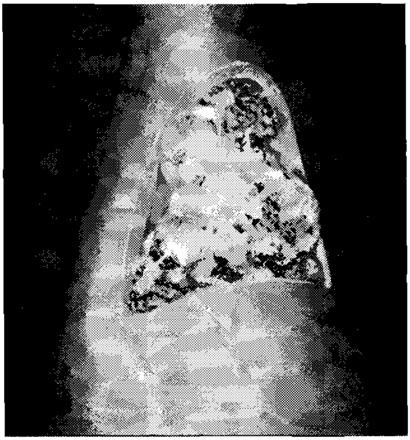


Figure 9 — With smaller condensers conventional cohesive pellets now forced into each of the retention areas separately. Extreme care is taken to have these areas as dense as possible.

Figure 10 — By placing conventional pellets over the entire surface and condensing them with a rather smooth instrument, the base of the foil becomes one unit to serve as the foundation.

Figure 11 — Laminated foil is now placed, after annealing, over the various areas so that they will overlap and cover portions of the cavosurface margin They are condensed against the axial wall for a small foot condenser.

Figure 12 — The marginal areas are covered with a single piece of laminated foil and each package is tied into the body of the restoration adding to integrity of the mass.

The three retention areas are finally connected by further application of cohesive pellets against the pulpal area; usually a small foot condenser is used for this area, which produces a rather smooth and shiny surface. The most desirable surface cannot be produced with the highly serrated instrument; rather, it should be relatively smooth (Fig. 10).

At this stage the adaptation of the laminated gold is indicated. The triangular packages of laminated foil are carried into the cavity with the aid of a curved and finely pointed cotton plier or carrier which requires less heat and time in annealing the gold. The first portion of laminated foil covers the gingival wall and margins, and while there is good access, the labio and linguo-gingival angles are covered with reasonable excess (Fig. 11). At this area this material is easily condensed where difficulty is often encountered with other forms of pure gold. All margins are now covered with other packets of laminated foil, allowing them to overlap on the axial wall (Fig. 12). Usually it is advantageous to finish the final restoration with conventional pellets of cohesive gold (Fig. 13).

Figure 13 (left) — The depressions and flat areas toward the center of the restoration and the final finish are more efficiently contoured with the application of the conventional hand-rolled pellets.

Figure 14 (right) — The restoration may be finished with well polished surface and excellent marginal adaptation.

Figure 15 — Lingual view of foil restorations which replaced defective plastic and silicate fillings. They withstand the heavy abrasion from the mandibular incisors because of the long-bevel protected margin and maximum retention form.

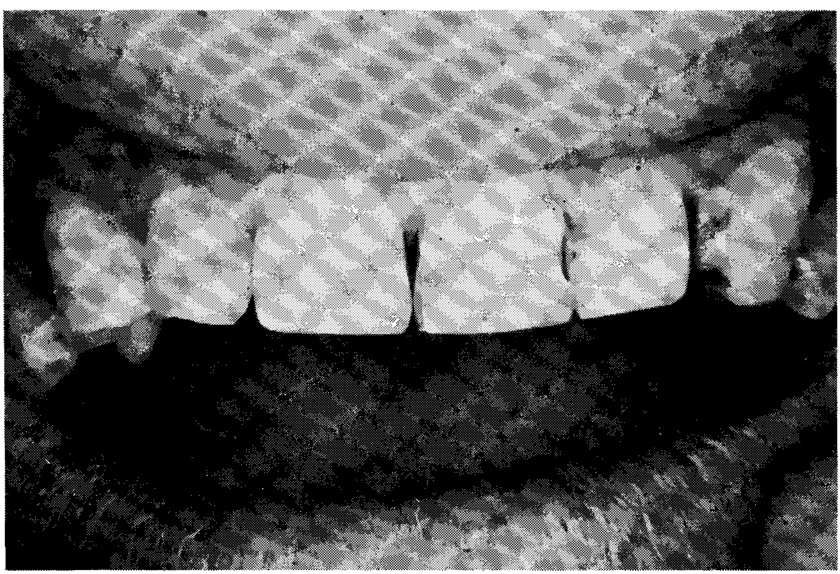


Figure 16 — The labial view of the restorations in Figure 15 shows very little gold of the seven separate restorations. Labial extension of the left cuspid was necessary because of a large defective plastic filling.

When the margins are covered with laminated foil, they appear to have excellent adaptation and are easily finished with knives, discs, burs, stones and strips (Fig. 14). There is a sense of greater security during and following the finishing process, and the operator need not be faced with the disappointment encountered when a volume of gold often peels away from the mass of the restoration.

The combination usage of various materials, herein d scribed, seems well suited for the larger restorations in which it is often necessary to replace large defective silicates and resin fillings (Figs. 15, 16).

SUMMARY

1. It has been found in clinical experience that laminated foil can be used to decrease operating time in building direct gold restorations with excellent clinical characteristics.

2. Deeply serrated condenser points are not desirable, but they may encourage uncleanliness and contamination.

3. Cavity preparation for Class III direct gold restorations should be re-evaluated to produce more positive retention and convenience. The spiral drill is most useful.

4. Failures, after years of service, are often caused by displacement due to inadequate retention areas and insufficient beveled margins.

5. For the inconspicuous anterior interproximal restoration and other areas of difficult access, laminated foil more effectively covers problem margins.

References

1. Hollenback, George M., Personal Statement to Author at USC Meeting of American Academy of Gold Foil Operators. November, 1965.
2. True, Harry A., Inconspicuous Class III Gold Foil Restorations. *JADA*, 30:1352-57, Sept, 1943.
3. Peffery, Alexander, Invisible Class III Gold Foil Restorations. *JADA*, 54:1-6, Jan., 1957.
4. Hollenback, George M., The Why and The Wherefore of Laminated Cohesive Gold. *J. of the Alabama Dental Association*, 47:17-19, Oct., 1963.
5. Nelson, R. J., Wolcott, R. B. and Paffenbarger, George, Fluid Exchange at the Margins of Dental Restorations. *JADA*, 44:288-295, March, 1952.
6. Markley, Miles R., Pin Reinforcement and Retention of Amalgam Foundations and Restoration. *JADA*, 56:675-679, May, 1959.
7. Courtade, Gerald L., Sanell, C., and Mann, A. W., The Use of Pins in Restorative Dentistry. *J. of Prosthetic Dentistry*, 15:691-709, July-Aug, 1965.
8. Stebner, C. M., Correlation of Physical Properties and Clinical Aspects of Gold Foil as a Restorative Material. *Dental Clinic of North America*, Nov., 1958.
9. Swartz, Marjorie L. and Phillips, Ralph W., In Vitro Studies on Marginal Leakage of Restorative Materials. *JADA*, Vol. 62, Feb., 1961.
10. Eames, Willmer B., A Sequence of Related Amalgam Procedures. *Practical Dental Monographs*, Year Book Medical Publishers, Inc.
11. Koser, John R. and Ingraham, Rex, Mat Gold Foil with a Veneer of Cohesive Gold Foil Surface for Class V Restorations, *JADA*, Pages 714-272, June, 1956.

Dam Gems

It is the intent of the Rubber Dam Committee to publicize, at regular intervals, various techniques that will be of use to students and practitioners. Some of these will be time-proven and others will be new. Your comments, suggestions and ideas for assisting others with various steps of dam techniques will be appreciated. If photographs are necessary, the Committee will make every effort to be of assitance to you. Please send your ideas to Cdr. Loren V. Hickey, DC, USN, Dental Service, U.S. Naval Hospital, San Diego, California 92134.

MODIFY CLAMP

(When utilizing the Young's frame)

In the rubber dam application technique for children, it is helpful to cut small slots in each wing, anterior to the holes for the forceps. A plastic instrument then easily engages the dam to pass it over the wings.

TWO PAIRS OF CLAMP FORCEPS

It has been found that the time required to apply the dam is reduced, in certain cases, if two pairs of forceps are used. For example, having seated a clamp on a tooth, the operator hands his assistant the forceps and she is immediately able to hand him the second pair loaded with the second clamp. In cases where a third clamp is needed, the assistant can have it loaded on to the first pair of forceps.

Suggested By: Dr. Terence Knight,
Johannesburg, South Africa

Dam Removal

The operator removes the clamp, cuts the interseptal rubber dam. He gathers the rubber dam and napkin and then carefully wipes the patient's lips with the dry peripheral portion of the napkin. The assistant immediately wipes the patient's lips with a slightly moistened 4x4 gauze spone.

Suggested By: Dr. James P. Vernetti,
Coronado, California

Wedge Modification

Wood wedges from tooth picks or tongue blades are commonly used with matrices or to protect the dam during cavity preparation. The wedge may be easily and rapidly modified with a Joe Dandy or separating disc in preference to cutting with a scalpel which is slower and may be unsuccessful because of wood grain direction.

Suggested By: Capt. L. V. Hickey,
San Diego, California

Program

INTERIM MEETING

AMERICAN ACADEMY OF GOLD FOIL OPERATORS
UNITED STATES NAVAL BASE
GREAT LAKES, ILLINOIS
February 3, 1967

Essay Program

9:15 a.m. "GOLD FOIL — A WAY OF LIFE"
Dr. Olin Loomis, Seattle, Washington

10:00 a.m. "AN EVALUATION OF FIXED SEPARATORS FOR OPERATIVE PROCEDURES"
Dr. Homer Dyer, Seattle, Washington

10:45 a.m. "BIOLOGIC IMPLICATIONS OF DENTAL RESTORATIONS"
Dr. Gordon Christensen, Lexington, Kentucky

11:15 a.m. "RUBBER DAM IN DENTAL PRACTICE — METHODS, CURRENT CONCEPTS AND ADDICTION"
Dr. Carl Monacelli, Brookline, Massachusetts

1:00 p.m. **CLINICAL DEMONSTRATIONS**

Class II

Dr. Donald K. Phillips	Nebraska City, Nebraska

Class III

Dr. R. C. Weiland	Lincoln, Nebraska
Dr. Charles Stebner	Laramie, Wyoming
Dr. Ralph Werner	Menomonie, Wisconsin
Dr. Anthony D. Romano	Pine City, Minnesota
Dr. Richard Lammermayer	Kennilworth, Illinois
Dr. Donald Welk	Lexington, Kentucky
Dr. R. Donald Roerster	Seattle, Washington

Class IV

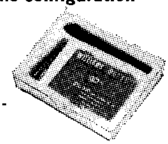
Dr. Paul Dawson	Chicago, Illinois

Class V

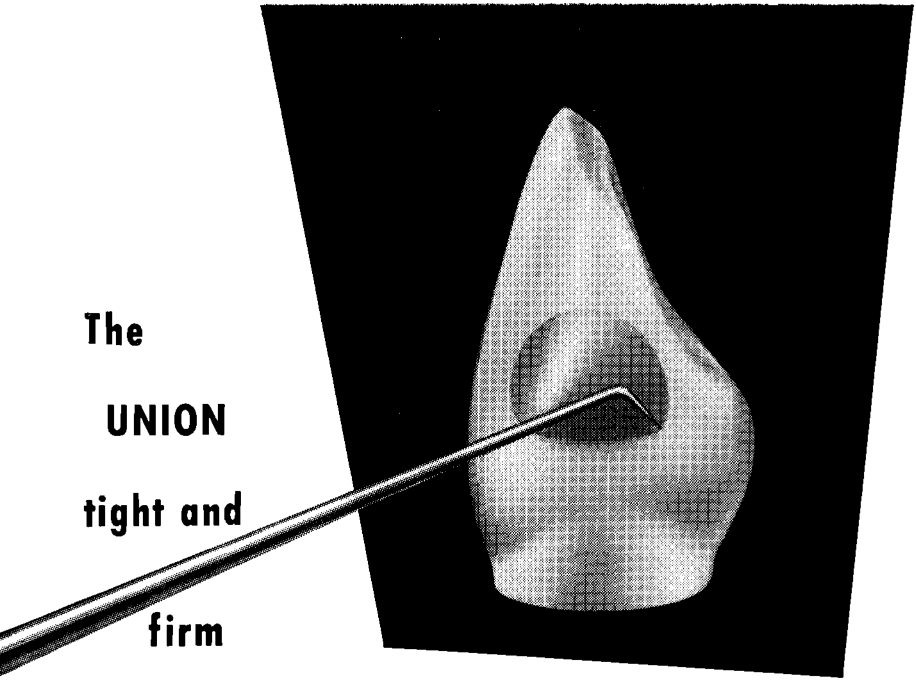
Dr. John Wittrock	Lexington, Kentucky
Dr. Jack Manning	Chicago, Illinois
Dr. William Walla, Sr.	Fremont, Nebraska
Dr. Homer Dyer	Seattle, Washington
Dr. James Vernetti	Coronado, California
Dr. Hunter Brinker	Orlando, Florida
Dr. Julian Thomas	Bethesda, Maryland
Dr. Harry McGee	Omaha, Nebraska
Dr. Carl Monacelli	Brookline, Massachusetts

5:30 p.m. Social Hour and Dinner

8:00 p.m. "WHAT IS NEW IN THE NAVY DENTAL CORPS?"
Admiral Frank M. Keyes,
Chief of the United States Navy Dental Corps.



The **UNION** tight and firm



FOR A LONG LIFE!

Only the Gold Foil can last for the longest lifetime because only the Gold Foil forms with the natural tooth a union that is *interlocked* and tight! And such a union is made best with "M-H" Extra Pliable Cylinders.

A perfect balance of cohesiveness and softness makes them the *easiest-working* Foil ever offered to the dental profession. Responding to the condenser instantly, they pack easily and rapidly into a dense, resistant restoration of great edge-strength and unsurpassed hardness. They do not balk at the condenser, but follow pliantly, going true to the mark the very first time they are condensed to place.

Feel their responsiveness under your own condensing point. Enjoy thrilling delight you never experienced before!

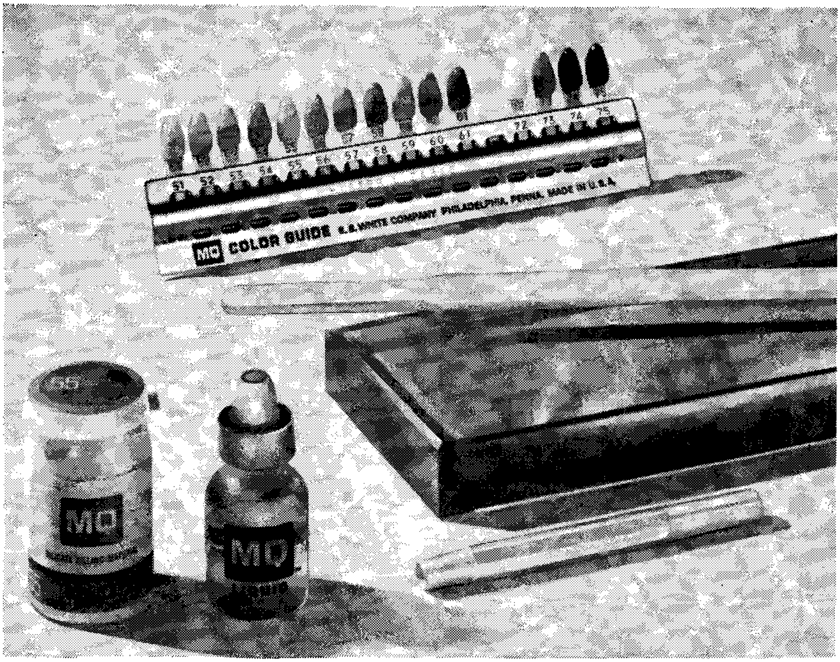
MORGAN, HASTINGS & CO.
2314 Market Street, Philadelphia 1, Pa.

Please send, through my dealer, 1/40 oz. of "M-H" Extra Pliable Cylinders — price, $3.40.

Doctor..

Address..

Dealer..


MQ COLOR GUIDE
MQ
MQ

WHAT ABOUT The Rubber Dam?

New users, ardent boosters and leading authorities state:

"Probably no other technique, treatment or instrument used in dentistry is so universally accepted and advocated by recognized authorities . . ."

". . . marks the beginning of better dentistry."

". . . improved vision . . . better cavity preparations invariably result . . ."

"When the rubber dam comes through the door, slipshod methods go out the window."

". . . one of the easiest technical procedures which the dentist performs . . ."

"The most time-consuming thing about the rubber dam is the time required to convince dentists that they should use it."

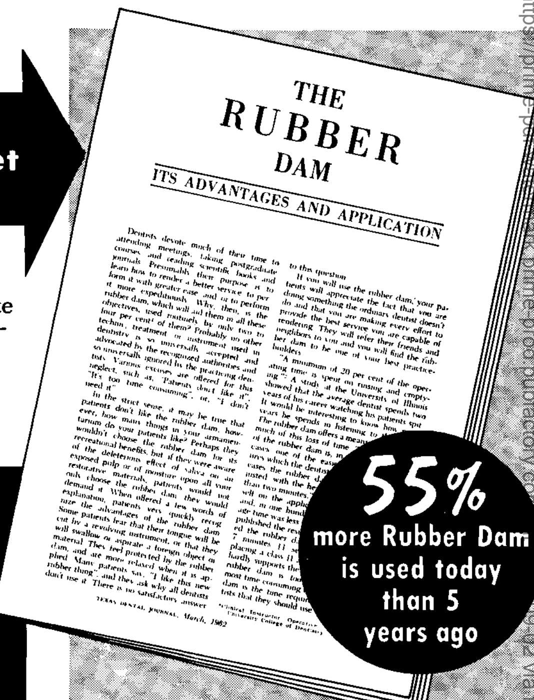
". . . not only has my work improved but good operative dental service has become easier to provide."

". . . the best assurance of the dry field necessary for good amalgam restorations."

". . . repaid many times over in income as well as self-satisfaction."

You owe it to yourself to get all the facts on The Rubber Dam

Send for this Detailed and Illustrated Booklet The Rubber Dam


THE RUBBER DAM

ITS ADVANTAGES AND APPLICATION

TEXAS DENTAL JOURNAL, March, 1962

55% more Rubber Dam is used today than 5 years ago

10 pages with the answers to all your questions . . . advantages . . . public acceptance . . . plus complete application techniques fully illustrated.

If you have never tried it, or if you are a "sometime" user—this frank discussion and detailed explanation will bring you to a new

15 photographs accurately supplement the text.

appreciation and thorough understanding of the rubber dam. Examine the reasons why many dentists have said that if they were deprived of its use, they would not continue to practice or would specialize in a branch not requiring its use.

MAIL THIS COUPON TODAY FOR YOUR FREE COPY

THE HYGIENIC DENTAL MFG. CO.

1230 Home Ave., Akron, Ohio 44310

Gentlemen:

Please send me, at no obligation, a copy of the 10-page booklet, "The Rubber Dam."

Doctor ____________________

Address ____________________

____