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Mat Gold—Gold Foil Restoration

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During the past several years, the use of cohesive golds gradually has been increasing in the daily practice of dentistry. It is difficult to determine the motivating influence that has created the increase in interest in this type of restorative service. Perhaps some of the credit can be attributed to the research responsible for the development of new materials, the perfection of clinical techniques which have improved manipulative procedures and the ever-constant influence of the American Academy of Gold Foil Operators, which continually has been emphasizing the need for higher levels of operative services.[1]

The purpose of this presentation is not to delve into all forms of cohesive golds, but primarily to discuss mat gold and its relationship to total restorative services. Mat gold is only one of the many types of cohesive golds available to the profession today. Each of these golds possesses certain qualities and properties which are suitable for specific restorative procedures.

INDICATIONS

As a general rule, operators prefer to use mat gold in areas not subjected to a great deal of stress. Most operators have found that, if the material is subjected to these forces, the probability of failures is enhanced. When mat gold is covered with a veneer of cohesive gold foil, the surface is made more resistant to staining and fluid penetration. A veneer of this type also improves the burnishing potential and the marginal adaptation of the finished restoration. Hence, a large number of operators 2-4 prefer using mat gold primarily as a core in restoring the greatest bulk within a cavity preparation and covering its surface with a veneer of gold foil.

Perhaps the best indication for the use of mat gold is in Class V restorations, where success usually can be predicted with a restoration of mat gold—gold foil combination. The procedure enables the operator to restore the surface with great efficiency and with the least amount of trauma to the tooth and its supporting structures. However, it should be kept in mind that, even though mat gold seems easy to manipulate, it must be condensed in a systematic manner, paying particular attention to all the essential fundamental principles of cohesive gold condensation. Failures that occur from using mat gold can be attributed partially to the lack of application of fundamentals. The material appears to handle so easily that it gives the operator a "false sense of security" and a tendency to become haphazard in his approach.

This paper will discuss in some detail the insertion of mat gold in a Class V restoration. It is not the intent to de-emphasize its use in other areas of the mouth. Time and space preclude the detailed approach to all phases of restorative dentistry where mat gold could and is used in a dental practice.[3-10] The reader is requested to review the literature, particularly those articles found in the reference list, which describe in detail the uses

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of cohesive golds. The authors of these works are considered to be pioneers in this aspect of restorative dentistry.

PREPARATION OF THE AREA

All restorative procedures require the application of certain fundamental principles, which, in some instanccs, should be employed universally and which, in others, are applied specifically to the service in question.[4,11-15] The application of a well-placed rubber dam is an essential fundamental for all restorative services; the application of a cervical tissue retractor is a procedure employed routinely for Class V restorations and is almost entirely restricted to this type of service.

Rubber Dam Application

A dark, extra-heavy, six-inch by six-inch rubber dam, including at least one tooth anterior and posterior to the one being restored, but preferably including a larger area, is an essential procedure before restorative services are started for a Class V lesion. The darkness of the dam provides greater contrast; the extra heavy weight assures a better retracting ability of the surrounding soft tissues; the six-inch by six-inch size allows for sufficient dam to provide the necessary accessibility through the retraction of the lips and cheek where indicated. Figure 1 depicts the application of a rubber dam.

It is imperative that the rubber dam be punched in a manner which will allow for complete dryness and for total coverage and protection of the internal papillae and other gingival tissue. It stands to reason that the openings must be as small as possible in order to produce the necessary tightness around the teeth, yet large enough that, when passing the dam through the contacts, the possibility of tears is eliminated. The opening for the tooth to be restored for a Class V should not be punched in the same alignment with the remaining arch, but should be moved buccally or labially at least one millimeter or more, if necessary, in order to provide sufficient dam to cover and retract the soft gingival tissues. If this allowance is not made, the edge of the interdental rubber dam will rest under tension on the papilla or will slide into the gingival sulcus, thereby exerting excessive pressure and hindering the blood supply to this tissue.

The placement of the rubber dam can be facilitated by the use of a lubricant, such as latherless cream, a small amount of mild liquid soap or a water-soluble ointment base. The use of a lubricant facilitates the insertion of the dam through the contacts. The utilization of the services of a dental assistant in holding the rubber dam, in applying air at the tooth surfaces and in all other aspects of rubber dam placement, is an essential feature in the efficient use of the dam in dental practice.

Figure 1. *Application of rubber dams.*

Rubber dam clamps should be utilized when necessary; however, most operators are of the opinion that these clamps are helpful in the initial placement of the dam but should be removed as soon as possible to provide greater comfort for the patient during long operative procedures. The use of these clamps is restricted to the posterior or distal end of the dam, for the purpose of holding it in place while inversion and adjustments are affected. The same result can be achieved by inserting a small piece of rubber between the contacts of the posterior teeth, or by applying a ligature to which an anesthetic carpule rubber plunger or a burlew wheel previously has been attached. The latter method works extremely well when the tooth in question has an edentulous area on the distal.

Generally speaking, individual tooth ligatures may be used, if needed, but their use should be limited whenever possible because of the potential hazard of injuring the interseptal tissues.

Gingival Tissue Retracting Procedure

In order to provide an outline form to the final preparation which will allow maximum harmonious effect and the best physiological contour to the tooth surface, the gingival margin of the restoration should be carried under the free margin of the gingival tissue.[9,16] To accomplish this objective, the tissue must be retracted and held in this position until the restoration has been completed. The best instrument for accomplishing this retraction is the Ferrier #212 clamp. The word “clamp” gives a connotation of a device used for grasping, clamping or grabbing onto a tooth. The term “tissue retractor” is preferred, since it is more explicit in denoting the use of the instrument. The retractor should in no way grasp the tooth, but rather it should allow for freedom of movement gingivally without tension on the tooth. It means, then, that the temper should be removed and the beaks of the retractor smoothed and reshaped to allow for its proper utilization.

The retractor is carried over the tooth by the aid of the rubber dam clamp holder and placed slightly supragingivaIly, avoiding any impingement upon the gingival tissues. The finger of one hand is used on the lingual surface to prevent the lingual beak from sliding gingivally. The other hand is used to slide the labial beak gingivally with the assistance of a modified crochet hook. It may be necessary to repeat the labial retracting motion after waiting a few minutes. Careful, intermittent pressure prevents damage to the gingival tissue. Once the retraction has been obtained, the retractor is held in place with one hand, while modeling compound is adapted under its wings for stabilization. A small amount of varnish placed over the adjacent teeth will greatly enhance the application and maintenance of the compound. The dental assistant again plays an extremely useful role during this entire procedure.

It is always wise to apply additional compound on the lingual surface of the tooth to be restored, extending from the distal to the mesial wings of the retractor. This extra amount of material will also aid in the stabilization of the retractor and will afford additional support to the tooth, greatly reducing traumatic injury during preparation and, particularly, during condensation.

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The Ferrier #212 "clamp" should be modified for every operation. Several of these "clamps" should be available in the event a wing has to be removed, a lingual beak bent occlusally, a labial beak bent gingivally or any other change deemed necessary has to be affected. As a matter of fact, a variety of these modifications can be prepared in advance and made a part of the regular armamentarium.

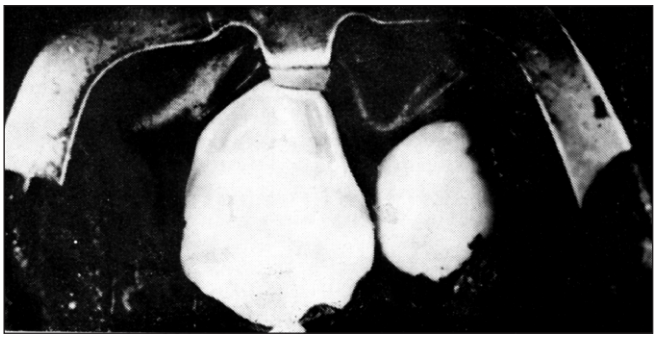

Figure 2. *Outline form.*

Modifications in the placement of this tissue retractor (Ferrier #212), such as using cotton rolls under the lingual beak or making incisions on the gingival tissue, may be employed when judgment demands these variations in techniques. Regardless of the procedure, the important considerations are the protection and preservation of the vitality of all surrounding soft tissues. Prevention of loss of tissue health is of paramount importance in all restorative procedures.

CAVITY PREPARATION

The author feels that the Class V cavity design most conducive to the use of cohesive gold is the one which incorporates the basic principles originally described by Dr WI Ferrier.[6] Basically, the preparation is made with sharply defined internal angles and parallel walls opposing each other. A trapezoidal design, with the small base of the trapezoid at the gingival area, provides an excellent outline for cohesive gold restorations. The mesial, gingival and distal margins of the preparation are placed in an area where the gingival tissue covers them; the occlusal or incisal margin is made to conform to either the occlusal plane or the cervical gingival contour. The choice of the shape of the occlusal or incisal margin depends upon the area of the mouth involved and the anatomical and physiological features of the particular patient. The ultimate goal is to provide an outline form that will be in complete harmony with the tooth and all its surrounding tissues (Figure 2).

The internal outline is made up essentially of right angles that are precisely defined. The axiogingival line angle is prepared acute to enhance the retentive potential of the preparation. The axial wall is made equi-distant from the surface of the tooth and almost invariably will present a convex surface. Instruments used for the preparation of the cavity are the #34 tungsten

carbide bur, a small straight chisel, a small hoe, a small curved chisel and a pair of angle-forming chisels. Needless to say, the efficiency of the operation and the accuracy of every detail depend almost entirely upon the use of sharp rotary and hand cutting instruments. Sharp instruments are a prerequisite for all restorative services.

Upon completion of the cavity preparation, the walls should be cleansed by scrubbing with a pledget of cotton soaked in three percent hydrogen peroxide. This procedure tends to remove a large percentage of debris from all internal and external surfaces. A mild blast of warm air usually takes care of eliminating the excess hydrogen peroxide. After the cavity has been cleansed and dried in this fashion, the dentinal walls should be coated with two layers of varnish to seal the tubules from the potential hazard of microleakage. The varnish may be applied by using a minute piece of cotton on a pair of tweezers, or preferably, by using a small piece of cotton wrapped around the tip of a thin, old, root canal file. The most important consideration is to apply two thin continuous layers of the varnish throughout the dentinal portions of the preparation. If some of the varnish adheres closely to a margin, it is best to allow it to remain undisturbed, since an attempt to remove it may result in a disturbance of continuity of this coating necessary for the protection of all internal portions of the preparation

SELECTION AND PREPARATION OF THE GOLD

Even though several types of gold are available, and various techniques for their placement are being practiced today,[3,17-19] time does not permit a full discussion of all these variations. This paper will be restricted to the use of one technique, realizing fully that other methods are just as acceptable or perhaps even better, depending upon the individual operator's knowledge and ability to perform the service. This discussion will deal mainly with the use of mat gold as a core with a gold foil veneer on its surface.[3,18]

The mat gold preferred by the author is the one commonly known as mat-foil. This term is used to describe an available mat gold which can be obtained in strips of two different widths and is wrappped or covered by a layer of gold foil. Mat gold by itself has certain weaknesses, particularly a tendency to crumble under condensing forces. The cover of gold foil gives mat-foil resistance to crumbling and thereby affords the operator an opportunity to condense it with less difficulty.

The width of mat gold selected for the restoration is dependent upon the dimensions of the cavity occlusogingivally. The width should be the one that provides the greatest proximity to this dimension. The strip thus selected is then cut into trapezoidal cantles, the size of which is related to the mesiodistal dimension of the preparation.

The gold foil to be utilized for the veneer will be used in the form of pellets, preferably hand-rolled. The author feels that hand-rolled pellets are softer and are adapted more easily to the cavity preparation. The pellets are made from No 4 gold foil (a sheet of gold, four inches by four inches, weight four grains) and are of a 1/64 size. There are times when a larger pellet (1/32) or smaller pellet (1/128) may have to be used during the condensation. It is important that the pellet size utilized be as small as possible to provide the means by which better adaptation and density can be achieved.

Both the mat-foil and the gold foil pellets must be annealed in order to remove prevailing contamination, such as moisture or NH_3 gas. This annealing process cleans the gold and makes it cohesive. One of the means for accomplishing this procedure is to pass the gold through an alcohol flame until the material turns cherry-red in color. The process takes a very short time and care must be exercised not to overheat the gold, which will make the material extremely harsh and difficult to work with. Underheating, of course, also should be avoided, because the remaining contamination would result in gold that is only partially cohesive. The instrument used for picking up the gold and passing it through the flame should be made of a non-oxidizing metal to avoid the potential hazard of carbon contamination. For the same reason, the pellet of foil or cantle of mat gold should never touch the wick of the alcohol lamp. Extreme care in the proper preparation of the gold is essential for a successful restoration.

CONDENSATION

The technique of condensation for all forms of cohesive gold always has been the subject of great discussion whenever operators share experiences. Each operator, being an individualist, will develop a methodology and assemble an armamentarium that effectively accomplishes his objective. However, what one operator utilizes under a certain environmental setup with the assistance of his individual health team may in no way be a satisfactory nor efficient procedure for another operator under different conditions. In my opinion, more emphasis should be given to an understanding of fundamental principles and to the development of clinical judgment, which can then be applied by any operator under any set of circumstances.

Fundamental Principles

The restoration of any cavity preparation with cohesive gold requires the development of a precise, systematic order of procedure. There is no place in this phase of dental service for a haphazard approach with a disregard for keen attention to every detail. The operator must develop a discipline whereby all biological and technical considerations are constantly observed if he is to render a long-lasting health service. The integrity of the tissues and their physiological importance always must be preserved.

One of the greatest side benefits derived from the utilization of cohesive golds in a dental practice is the development of a self-discipline, which invariably affects all other aspects of patient care. Operators are more aware of their assets and liabilities, and they become more motivated to render excellence of service whether it be in the preventive, restorative, periodontal or any other aspect of patient care. Attention to detail, then, together with the development of a systematic order of procedure, are essential fundamentals in developing self-discipline. This discipline should go hand-in-hand with a sincere motivation for excellent service regardless of its nature.

A fundamental principle greatly affecting the adaptation and density of the final restoration is the line of force used. This applied force should always be directed so as to bisect all internal line angles and trisect internal point angles. Such a line of force accomplishes an excellent wedging of the gold and, consequently, enhances its adaptation to all walls. If this line of force is maintained, the Class V restoration always will display a concave or saucer-shaped surface during its buildup. The concavity demonstrates the operator's self-discipline in applying this basic fundamental.

Stepping of the condensing point is another principle having great effect upon the density and adaptation of the restoration. This principle requires the operator to demonstrate a rigid self-discipline. Every time the point is raised and reapplied, it should overlap the previous condensing blow or step until a row of these steps or blows is accomplished. Every additional row of steps must overlap the previous row, always keeping in mind that the individual steps within the row must also overlap the preceding steps. The mass of gold always should be stepped from its center to the surrounding walls of the preparation. This movement of the point enhances the wedging ability of the gold. The entire procedure, paying careful attention to every detail, is known as "stepping" the gold and is perhaps the most important single factor during the entire condensation. When it is carried out with precision, the surface of the condensed gold will present a uniform, stippled appearance. This, coupled with the concavity resulting from proper line of force, will give assurance to the operator that fundamental principles are not being violated. The final restoration should have good adaptation, sufficient density and no porosity.

The technical principles described are basic in nature but in no way reflect all the fundamentals to be considered. Preservation of the vitality of the pulp and the prevention of traumatic injury to the supporting structures of the tooth are also of paramount importance. The value derived from a beautifully condensed restoration with subsequent death of the pulp or damage to the periodontal structures leaves a great deal to be desired. Proper line of force is of great assistance in diminishing traumatic injury, but it must be supplemented by the exertion of minimal condensing blows and additional support to the tooth. The use of as small a point as possible (requiring less magnitude of force) and the utilization of a finger to offer additional support to the already compound-supported lingual surface are two essential fundamentals to minimize these biological complications. Condensing blows of less magnitude but delivered with greater frequency will do much to decrease trauma; the finger support will tend to prepare the tooth to receive the blows, will absorb or cushion the blows, will help to distribute the resultant forces, and, hence, will prevent sudden jarring of the tooth and its periodontium and, thereby, decrease the potential traumatic injury.

Another fundamental biological consideration is the prevention of damage to the enamel and cementum margins. Margins that have been prepared with precision, definition and smoothness for the purpose of obtaining maximal marginal seal and ideal harmonious relationship should be protected during the condensing procedure. Crushed or chipped enamel rods and dented or mashed cementum will result in margins that are subject to leakage with subsequent caries liability, margins that are in complete disharmony with the patient's esthetic requirements. This marginal protection can be accomplished either with non-cohesive gold cylinders or with cohesive gold foil pellets. The use of non-cohesive cylinders is not to be discussed in this paper, but it is an extremely useful method to provide this support and protection to the margins. The protection by the cohesive gold foil method can be affected by using a double thickness of small pellets condensed first with *hand pressure* to the already condensed mass, then laterally against the walls and finally folded over the margins using the side of the condensing point. The process is carried out around all the margins until two thicknesses (two pellets) are adapted with hand pressure. This amount of gold provides the necessary cushion to preserve marginal integrity.

It should be pointed out that these technical and biological fundamental considerations indeed are applicable to all dental services. However, while some other restorative procedures are capable of compensating for an operator's indifference, cohesive golds require strict adherence to every detail. The operator who constantly attempts to achieve perfection and who always is motivated by the desire to render high quality services will find that the previously mentioned fundamentals are essential to the routine daily practice of dentistry.

Armamentarium

The condensation of cohesive gold requires the use of hand pressure as well as malleting pressure. The mal-

leting can be accomplished efficiently with a hand mallet or with mechanical devices that can be regulated insofar as the magnitude and frequency of the blow desired for condensation. The selection of the methodology of condensation (hand mallet vs mechanical) is of less significance than the application of a technique designed around the fundamental principles outlined previously. However, the author considers hand malleting to be one of the least traumatic methods, because the tooth is prepared to receive the blow (first tap) before the actual condensing blow is delivered (second blow). Electronic condensation also is relatively non-traumatic, since the magnitude of the condensing force can be maintained at a low level through an increase in the frequency of the blows. Regardless of method, it is best to use small size points which require minimal force of condensation but which are capable of condensing the gold with adequate pressure for obtaining the necessary density and adaptation.

The cantels of mat-foil are condensed first with hand pressure and then with malleting pressure. The points used for the hand condensation have fine serrations that extend around the edges of their faces. Sharp edges are avoided to minimize tearing of the material. Small foot and parallelogram condensers usually are employed. The malleting procedure makes use of the usual points for building a gold foil restoration, such as the small round, parallelogram and foot condensers.

The pellets of gold foil used for the veneer are condensed also with a combination of hand and malleting pressures. Hand condensation is used: 1) to mold the pellets into place prior to malleting and 2) to condense the double thickness of pellets necessary for the protection of all margins. The major portion of the condensation is accomplished by using a small parallelogram or rectangular point; however, some operators prefer a small round point throughout the entire buildup. The parallelogram has the additional advantage of being an efficient instrument for the lateral hand condensation when covering the margins. Surface condensation following the marginal protection can be accomplished best with a small foot condenser.

After the condensation has been completed, it is advantageous to use a larger foot condenser with shallow serrations to recondense the entire surface. The shallowness of the serrations permits a sliding effect on the point when the malleting is affected, and this movement results in surface burnishing with increased hardness and marginal seal. Small amounts of excess also can be removed with this point and some contour can be developed.

Technique

A trapezoidal cantle of mat-foil is placed on the axial wall and held in place with a holding instrument. The cantle is condensed with hand pressure following the systematic approach outlined earlier, beginning from the center of the axial mass and stepping the point towards the surrounding walls. The holding instrument must be moved from the mesial to the distal portions, or vice-versa, to allow for complete hand condensation of the cantle without dislodgement. This first cantle must be hand condensed thoroughly and accurately into all cavity internal angles. A second cantle is added and condensed in the same fashion. The entire mass then is stepped carefully, using the malleting procedure with a parallelogram point. Additional cantles are added, condensed first with hand pressure followed by malleting forces, until the mass of mat-foil approximates the margins (about 0.5 mm distance away from cavosurface angle). Two layers of gold foil pellets (1/64 size) now are hand condensed around all margins to create the protection, support or banking as described earlier. The parallelogram point is excellent in performing this step of the procedure. The formation of the protective marginal layer with the folding of the pellets over the margins not only produces the cushioning effect desired but also serves as a guide in the development of the cervical surface convexity of the restoration. In essence, the two-pellet layer reduces the size of the cavity outline, and all additional foil pellets are condensed following this established guideline. The condensation of the final central depression or saucer-shaped concavity can be accomplished best with a small foot condenser. Pellets of 1/64 size or larger (1/32) may be used at this time, constantly observing the previously discussed principles.

At this time, the restoration should possess a slight amount of excess, perhaps a bulk equivalent to the thickness of the two condensed marginal pellets. Minimal but adequate excess is imperative in order to minimize trimming time. The use of the foot condenser with shallow serrations and under high frequency of blows further reduces the amount of excess and begins to develop the necessary contour.

FINISHING

No two operators agree wholeheartedly upon a specific technique for the trimming and polishing of a Class V restoration. Each individual prefers the use of one method or another as it is related to his own environmental set of conditions. However, all agree that the gold should be burnished, all excess should be removed, excessive heat should be avoided, marginal integrity should be preserved, the surface should be smooth and have at least a velvet polish, and, lastly, but yet of great importance, that the contour should provide the physiological morphology necessary for the protection and stimulation of the gingival soft tissues. As long as these fundamentals are observed, then it matters little what the armamentarium consists of or

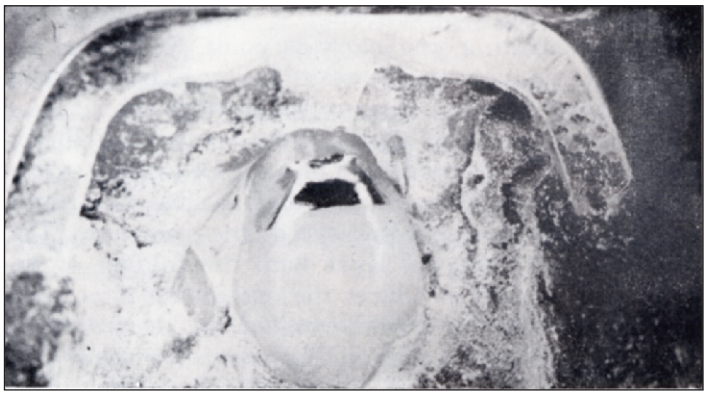

Figure 3. *Completed Class V restoration.*

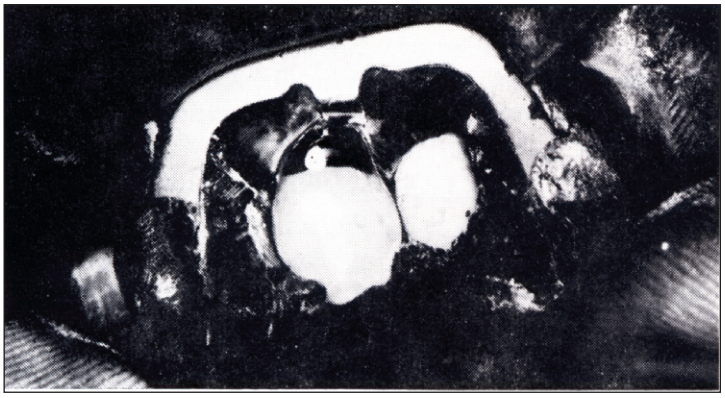

Figure 4. *Completed Class V restoration.*

what technique is employed during the finishing procedures.

When excess gold is maintained at a minimum, an instrument, such as the Spratley carver, can be utilized effectively to remove all excess and to contour the restoration. This instrument can carve, shave, trim and burnish the gold. Its use can be followed by using 3/8 inch fine discs (cuttle and crocus) to complete the trimming. However, if large amounts of excess gold are present, it is best to start the trimming by using 3/8 inch discs of a coarser grit (sandpaper—medium and fine), followed by finer grits. Smaller discs (1/4 inch size) are ideal for discing the gold near the gingival margin. Whenever discs are utilized, a thin coating of Vaseline should be placed on the abrasive surface, and air should be applied as a coolant. Small head mandrels are essential to allow for adequate accessibility.

Files, push knives, pull knives, stones, finishing burs, chisels and any number of other instruments are employed by different individuals to accomplish the trimming and contouring procedure. All operators at one time or another have utilized these instruments for a specific restoration. The important consideration is that a simplified armamentarium should be instituted to afford the opportunity for accomplishing the end result in the most efficient manner.

The final polish can be developed by using dry, extra-fine flour of pumice in an unwebbed rubber cup. Intermittent light pressure for a few seconds using air as a coolant produces the so-called velvet finish, which is sufficient for these restorations. An even higher gloss can be obtained by following this procedure with tin oxide or any other polishing material. Care must be exercised to avoid heat production and to prevent wearing of the cementum margins. Figures 3 and 4 are examples of completed Class V restorations.

Once the restoration has been polished, the tissue retractor (Ferrier #212) is removed with the aid of the crochet hook placed on the labial beak. The retractor is pulled labially and then occlusally, pivoting it on a finger placed under the lingual beak. The retractor thus can be removed with all its supporting compound without damaging the restoration or the surrounding tissues. The rubber dam then is removed and all gingival tissues are massaged carefully but vigorously. The patient is re-instructed as to his role in the maintenance care of this restorative service. Patient cooperation is essential if long-term service is to be achieved, particularly since it is a known fact that cohesive gold restorations are indeed the most durable, long-lasting and serviceable of any other available material in the practice of dentistry at the present time.

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