THE JOURNAL OF THE AMERICAN ACADEMY OF GOLD FOIL OPERATORS

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Robert B. Wolcott

"The ideal leader of men can listen reflectively, think creatively, talk inspiringly and work cooperatively."

This axiom must have been written about Captain Robert B. Wolcott, DC, USN, for he fits these qualifications to the letter.

Since his graduation from Marquette University Dental School in 1941, at which time he joined the United States Navy Dental Corps, he has constantly practiced and preached the gospel of good dentistry. His inquisitive mind and attention to minute details have led him to do considerable research, the results of which have been published in the *Journal of the American Dental Association* and in many state dental journals.

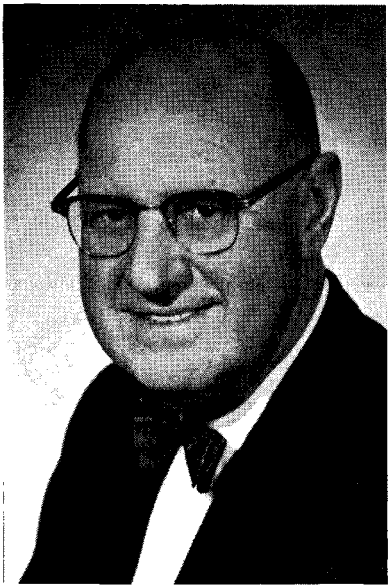
Dr. Wolcott's teaching abilities have been recognized by the Navy, for he has headed schools and teaching departments from Guam to Bethesda, Maryland. At the latter he was department head of Operative Dentistry. A further proof of his intense quest for knowledge is evidenced by the fact that while on active duty he found the time to obtain a M.S. degree in Chemistry from Georgetown University.

For his many contributions to the dental profession Dr. Wolcott has been recognized by election to the American College of Dentists. He is also a member of the International Association for Dental Research and the American Association for the Advancement of Science.

His special interest in gold foil developed during his tour as Director of Training at the Dental Technicians School in San Diego in 1956. Hearing that the John C. Metcalf Gold Foil Seminar was forming he sought membership, was readily accepted, and offered the facilities of the institution under his command as a meeting place. Though his activities in this group were at times criticized by some of his immediate superior officers, Bob, because of his strong convictions for good dentistry, continued his membership and was elected President in 1958. His leadership abilities were immediately recognized and since that time he has served as Secretary, Chairman of the Research Committee and President-Elect of the American Academy of Gold Foil Operators.

Our Academy is indeed fortunate and proud to have as its President a man of devotion, dedication and ability—one who is a natural leader of men and who has brought great credit to dentistry and to the Navy Dental Corps.

President-Elect



George A. Ellsperman

George A. Ellsperman, D.D.S., University of Southern California, College of Dentistry, 1917. Life-Member, American Dental Association; Life-Member, Washington State Dental Association; American Academy of Restorative Dentistry; American College of Dentists; Past-President, Whatcom County Dental Society; Past-President, Washington State Dental Association; Instructor, Vancouver Ferrier Dental Study Club; Lecturer, University of Washington.

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Charles C. Latham

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FORTHCOMING EVENTS

1961

October 12. Executive Council Meeting, Benjamin Franklin Hotel, Philadelphia, Pennsylvania.

October 13 and 14. Philadelphia, Pennsylvania. The Tenth Annual Meeting of the Academy to be held at the University of Pennsylvania, School of Dentistry, 4001 Spruce Street. Headquarters for the meeting will be the Benjamin Franklin Hotel. Details and preliminary program will appear in the next issue of the *Journal.*

October 16-19. Philadelphia, Pennsylvania. American Dental Association Meeting. Requests for hotel reservations should be made on the application form directly to the American Dental Association Housing Bureau.

1962

February 17. Interim Academy Meeting. A one-day meeting to be held at Northwestern University, School of Dentistry, preceding the Chicago Mid-Winter Meeting.

RESTORATIVE DENTISTRY AND PERIODONTAL HEALTH*

Lyle E. Ostlund,** D.M.D., Everett, Washington

It is generally recognized that local factors contribute significantly to the status of the health of the periodontal structures. Ramfjord states that "tissue changes found in the common types of periodontal disease, including periodontosis and atrophy, can be explained on the basis of reaction to local injury."[1] Whether local factors play a primary or secondary role in the etiology of periodontal disease cannot yet be conclusively determined, but the fact that there exists a relationship between local injury and the health of the periodontium can be verified clinically by appraising oral tissues as they respond to local irritants, such as accumulated foods, calculus and inadequate dental restorations.

If poor restorative dentistry does contribute to local injury, and there is every reason to believe it does, what considerations should the dental practitioner observe to promote and maintain periodontal health? The answer to this question is twofold: first, he must strive for the best possible results in all restorative procedures; and, second, he must maintain a constant surveillance of existing restorations for corrections and improvement of conditions that are responsible for detrimental tissue changes. In short, our treatment aim should be to promote the optimum in health of both the tooth and its investing tissues.

Dentists limiting their practices to adults rarely see mouths that do not require correction or replacement of restorations that are injurious to the periodontal structures. The reasons for failure are manifold, but will generally fall into the following categories: poor anatomical contours, poor functional anatomy and occlusion, and margins which produce gingival irritation.

Gingival Margin Irregularities

Recent research indicates that it is not surface roughness and marginal irregularities in themselves that cause tissue injury, but rather the effect of the accumulation of microorganisms on these imperfect surfaces.[2,3] Therefore, marginal excesses and deficiencies, unpolished restorations and exposure of the gingival tissues to the various dental cements assume new significance. This explanation of tissue reaction to local injury seems much more plausible than the previous opinion that gingival inflammation was the result of the mechanical irritation of marginal irregularities and poorly finished surfaces. Thus, our first concern in the maintenance of the oral

*Presented before the Ninth Annual Meeting of the American Academy of Gold Foil Operators, October 14, 1960, Los Angeles, California.

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structures should be the removal of factors which contribute to gingivitis.

These factors are too numerous to enumerate. Some are obvious; others microscopic and thus obscure and indefinite. The minimum service in health care dictates the removal of the obvious irritations at least. If marginal excesses occur in dental amalgam or gold foil, they can be removed and the surface or surfaces recontoured and repolished. However, if these "overhanging" margins occur on fused porcelain or on cast restorations where intermediary cementing substances are required, the removal of the "overhang" will surely produce a cement line and a condition that cannot be rectified without replacing the restoration. If there are deficiencies in contour, at or near the gingival margins, it would seem judicious to replace the restoration no matter which material is used.

If unpolished restorations are evident, the total restoration must be polished to provide maximal tissue acceptance and oral hygiene. The common practice of finishing and polishing only those surfaces exposed to view does not constitute an adequate operative procedure. Interproximal surfaces of silver amalgam restorations should be polished despite Sweeney's opinion that amalgam condensed against a highly polished matrix will yield a surface that does not require further finishing.[4] This viewpoint is not realistic if one but realizes that most interproximal surfaces restored with amalgam require some type of carving instrumentation, thus producing a roughened surface which requires polishing. If the surfaces of restorations are left unpolished, and/or poor gold foil condensation, casting porosity or pits from amalgam corrosion are evident, the restoration is defective and should be replaced to arrest or prevent tissue changes or poor oral hygiene.

A restoration fabricated of fused porcelain whose gingival portion has not been glazed, and which has produced gingival irritation, must be removed and replaced. Unglazed porcelain cannot be satisfactorily polished by any means other than glazing. For this reason the fused porcelain restoration must be adjusted on the tooth as to marginal fit and marginal contour, then removed and the ground surfaces adjacent to the gingiva fired to the proper glaze before cementation. A dental office not having at its disposal a furnace capable of fusing porcelain cannot deliver the maximal service in the prevention of periodontal disease.

Our profession, particularly the "restorodontists" and periodontists, has been duly concerned about marginal "overhangs," but what of the cementing substance between the restoration and the tooth preparation? Is it not probable that castings not having very close dimensional accuracy at the margins constitute an irritational factor for the reason that deficient margins filled with porous cementing substances cannot be polished? Therefore, if these defective cement-filled margins occur at the gingival of castings, and if inflammation is present, the existent restorations require replacement.

Physiological Tooth Form

The other corrective phase of treatment within the scope of the operative dentist in his care of the mouth should be the improvement of function. Again, as with etiological factors in gingival inflammation, functional factors are numerous and often obscure for the reason that normal or abnormal function can exist over a wide range, unique to each individual. However, these factors should not deter us from being objective and definitive in our corrective treatment program. Such treatment is possible by means of a thorough clinical and roentgenographic examination and the study of mounted casts on an acceptable articulator.

Even though this phase of the maintenance program might be time-consuming and not so economically remunerative as other procedures, success or failure is often dependent upon our skill of properly interpreting the clinical findings. This is particularly true when analyzing functional disharmonies of tooth anatomy and of the restoration, not only of the occlusal details but also of the axial surfaces, particularly as they relate to the surrounding tissues.

As mouths are observed over a period of time the tissue health picture might change due to temporary conditions, such as transient infections and allergies. However, chronic inflammatory changes of the gingiva occurring locally, that is, in a specific area and associated with the coronal portion of the tooth, should indicate to the clinician the possible need for corrective action, particularly in the realm of improvement of anatomical contours so they may better protect the periodontium from injury. These contours may have been brought about by gradual wear of the teeth, caries, gradual movement of the teeth, or their mutilation through improper restoration. The examining dentist should observe the presence, absence, and the location of such anatomical features as contact areas, embrasures and cervical ridges. If the conditions can be corrected by recontouring, this procedure should be instituted as positive treatment. However, if periodontal injury has been caused by the absence of proper contours, restorations must be placed even though the mouth does not indicate caries activity.

Functional Occlusion

The presence or absence of anatomic contours influences the health of the surface tissues, but what of the influence exerted upon the efficiency of mastication and patient comfort by the anatomy of the occlusal surfaces? Although opposing teeth do not come into direct contact during mastication, they should function harmoniously through the interaction of cusps, ridges, grooves and embrasures.[5] If the occlusal portions of existing restorations are not harmonious with that relation which is considered normal for the individual, efficiency of function is lost, and probable damage ensues. To alter the occlusal anatomy of the posterior teeth, or to completely restore it to harmony, would seem the only common sense approach to the

maintenance of the teeth, their investing tissues, and possibly the general health of the patient.

Another factor that should be of concern to the dentist engaged in restoring teeth is the awareness that occlusion is not only a mechanical relationship, but a physiological one as well. If restorations are not in harmony with all oral structures and are in hyperfunction too great for the individual tooth or group of teeth to withstand, the result is patient discomfort, increased tooth mobility, pulpal irritation, and changes in the deeper periodontal structures.[6]

At the other extreme, if teeth fail to function at all, either through restorations that do not make occlusal contact or through the loss of opposing teeth, there is usually a cellular change in the periodontal membrane, an altered tooth mobility, and a change in the surface tissue health through lack of oral hygiene in the area. It would seem both wise and desirable to restore these functionless teeth to normality through the use of restorative procedures.

Whatever the cause, when tooth mobility becomes so great that proper function becomes impossible and repair of the damaged periodontal structures unlikely, individual teeth can be stabilized by the technic of splinting. Splinting, as a means of effecting repair of periodontal tissue surrounding loose teeth, is currently receiving widespread attention. The methods of accomplishing tooth stability and function are as numerous as we are mechanically ingenious, ranging from temporary methods of treatment to permanent removable appliances and permanent fixed splints. That this treatment is not an innovation is apparent, for partial dental prostheses, both fixed and removable, are, in principle, splinting devices. Of the two forms of splints, the fixed type is superior in effecting tissue repair and accomplishing tooth stability.[7]

The principle of stationary splinting involves the use of cast restorations, by which a mobile tooth is rigidly attached to one or more healthy teeth by means of soldered joints. Whether these restorations are conventional inlays, inlays with pin retention, three-quarter crowns or full crowns is dependent upon existing restorations, position of the teeth in the arch, stress factors, length of the clinical crown, esthetics, caries activity and oral hygiene. Finally, no matter how good the restorative dentistry is mechanically, fundamental biomechanical principles must be understood and practiced if stationary splinting is to be successful.

Preventive and Corrective Measures

A discussion of the relationship between restorative dentistry and periodontal health would be incomplete if the restorative aspects did not include prevention, as well as maintenance care and corrective treatment. Whether rehabilitating a mouth that is in obvious need of restorative treatment, or restoring single teeth whose investing tissues are in apparent health, our responsibility should be to practice preventive dentistry. This ideal can be accomplished in the majority of instances by using to the highest refinement

modern dental technics and by the proper choice and manipulation of dental materials. If we could produce restorations with the surface finish of fused porcelain, the marginal integrity possible with gold foil, the anatomical form and function that the cast restoration affords, and the gentleness to tissue that amalgam manipulation permits, we would realize our goal of preventive dentistry.

However, there is no one material that will fulfill all of these desirable qualities, so choice of material and its manipulation often dictate whether our dentistry is truly a health service. Where, then, do the various restorative materials fit into the total preventive picture?

In operative dentistry, gold foil is the yardstick by which we measure the physical properties of other restorative materials. Does it have a similar role as the yardstick by which we can appraise biological aspects of tissue acceptance as well? We would have to answer "yes, with qualifications." Because it is possible to produce marginal excellence, good surface finish and contour, gold foil should be seriously considered as the material of choice for labial and buccal restorations, and for anterior interproximal restorations. However, esthetics, difficulty in manipulation and its softness limit its use to these non-stressed surfaces.

When esthetics and gingival tissue acceptance demand the use of another material other than gold foil for restoration of these unstressed areas, particularly in the anterior teeth and the upper bicuspids, fused porcelain restorations should be considered. Excellence of contour and surface finish, and acceptable marginal fineness are possible. Of course, when anterior crowns are indicated, either full porcelain veneer crowns or porcelain-gold combinations are the only materials that satisfy the demands of esthetics, strength and tissue acceptance.

In posterior teeth requiring complex restorations, esthetics is often of lesser importance, whereas function becomes the primary objective. The only material that can satisfy the requirements demanded is the cast gold restoration. This material offers the possibility of excellent results in contour, function, surface finish and acceptability in marginal excellence. With advancements in dimensional accuracy in the field of impression materials the indirect inlay technic affords the maximum in anatomically relating our complex restorations to the teeth being restored, to their approximating teeth, to their antagonists, and to the surrounding tissues, including not only the periodontium but also the muscles of mastication and the temporomandibular articulation.

It should be mentioned that the fulfillment of our clinical obligations in inlay and crown technics does not begin and end with the cavity preparation and the cementation of the highly polished and well-functioning restoration. It also means the placement of temporary restorations which are comfortable, functional, and biologically and physiologically acceptable to the tissues.

The consideration of the other permanent restorative material, amalgam, has been deliberately placed at the end of this paper. If our comparison of materials is from the standpoint of their contribution to total tissue health in the adult dental patient, amalgam offers less than the complex cast restoration. The very nature of amalgam makes it difficult to attain the desired results in the finished restoration. The variables induced by the operator, of such fundamentals as mercury-alloy ratio, trituration, matrix application, condensation, carving and polishing technics, must be meticulously controlled if satisfactory restorations are to be produced.

One of the greatest limiting factors of amalgam relative to periodontal health is the difficulty in attaining acceptable proximal contour and functional anatomy in complex restorations. Yet, acceptable proximal contours are possible through the use of custom-made matrices, properly contoured, fitted and stabilized.[8] However, there persists the common practice of using commercially-made circular matrices, uncontoured, without wedging and stabilization. Obviously, this poor technic cannot possibly, except by chance, produce the desired proximal contours, marginal ridges and embrasures, nor can these matrices produce the proper gingival fit, free from "overhangs." However, this material accounts for approximately eighty percent of the total number of restorations placed.[9] Is it any wonder that conscientious practitioners look upon amalgam and silicate dentistry as anything but a preventive health service?

Summary

We, as operative dentists, should look upon our professional endeavor as something more than selling "fillings and materials." We must consider seriously the important role we can and should play in the total oral health of the patient through well-conceived restorations. We must appreciate and understand those dental health problems that are interrelated with our field of operation. In turn, we should expect those engaged in the specialties to have a proper perspective of what constitutes adequate restorative dentistry, and a concern, appreciation and understanding of the problems involved in attaining this caliber of dentistry. When this understanding exists, it will contribute, not only to the elevation of dentistry in general but, more important, to the standard of oral health of the patient whose concern is his total mouth—its cosmetic value and its function.

423 Medical Dental Building

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THE 1961 INTERIM ACADEMY MEETING

On February 3, 1961 the Academy held its Interim Meeting at Loyola University, School of Dentistry, Chicago College of Dental Surgery. The morning session consisted of two scientific papers, one presented by Dr. Harbous Bhatia entitled "Reaction of Connective Tissue to Implants of Different Filling Materials," and another entitled "The Restoration of Anterior Teeth" presented by Dr. IanHamilton, Dr. Kenneth Morrison and Dr. Gerald D. Stibbs, representing the George Ellsperman Gold Foil Seminar.

The afternoon session was devoted to chair and table clinics on various gold foil procedures presented by the following clinicians:

DR. J. E. CHAPIN
DR. R. W. CHAPIN
Dr. H. CLINE
DR. H. F. GILLARD
DR. W. W. HOWARD
DR. A. JEFFERY
DR. W. J. KEMMET
DR. R. N. LAMERMAYER
DR. J. P. MCLOUD
DR. H. A. MERCHANT
DR. J. H. MILLS
DR. K. MURCHIE
DR. D. PHILLIPS
DR. T. I. TAYLOR
DR. J. P. VERNETTI
DR. W. M. WALLA
DR. H. E. WEBER
DR. R. J. WERNER

The entire program was very well received by those attending the meeting.

VITAL FACTORS INTERRELATING PERIODONTOLOGY AND RESTORATIVE DENTISTRY*

Alfred L. Ogilvie,** D.D.S., M.S., Seattle, Washington

Our perspective on the interplay between periodontology and restorative dentistry has been sharpened in recent years. Important basic studies relating the tooth and the periodontium continue to be made in this country and abroad. Concurrently, the range of interrelated procedures in periodontics and restorative dentistry has been greatly expanded. As a result, we now have a stronger therapeutic command over dental disease than existed even fifteen years ago.

The normal periodontium or surrounding tissue environment of the tooth can be more clearly visualized, in its functional and structural aspects at least, than ever before. In fact, it is now routine to consider the tooth and its immediate environment as an inseparable unit. Several fundamental interrelationships exist, and it seems worthwhile to review them in today's perspective.

The Periodontium

Our teeth gain support from an attachment apparatus which includes the outer tissue of the tooth root (the cementum), the housing of alveolar bone, and the specialized connective tissue between tooth and bone known as the periodontal membrane or periodontal ligament. Coronal to this, at the neck of the tooth, is the gingiva which covers and protects the deeper tissues. Considered as a part of the gingiva, yet with additional significance of its own, is the structural unit known as the epithelial attachment which links the tooth to its surrounding gingiva.

The precise nature of this union between gingival epithelium and tooth has been investigated by many, including Gottlieb,[9] Orban,[15,17] Waerhaug,[23] Weinreb,[31] Baume,[2,3] and Ussing.[22] The majority opinion of today sees an organic union of epithelium to tooth; in other words, an attached epithelial cuff.[18] The actual attachment is apparently cuticular or fibrillar or both. It is conceived to be the result of a maturation and cornification of epithelial cells originally having a tono-fibrillar linkage to one another and to the irregularities of the tooth surface.[3]

Strength and resistance to separation at the dentogingival junction, however, are derived not from the epithelial attachment but from the tight adaptation of the free gingiva to the tooth. Collagenous connective tissue fibers arising primarily from the

*Presented before the Ninth Annual Meeting of the American Academy of Gold Foil Operators, October 14, 1960, Los Angeles, California.

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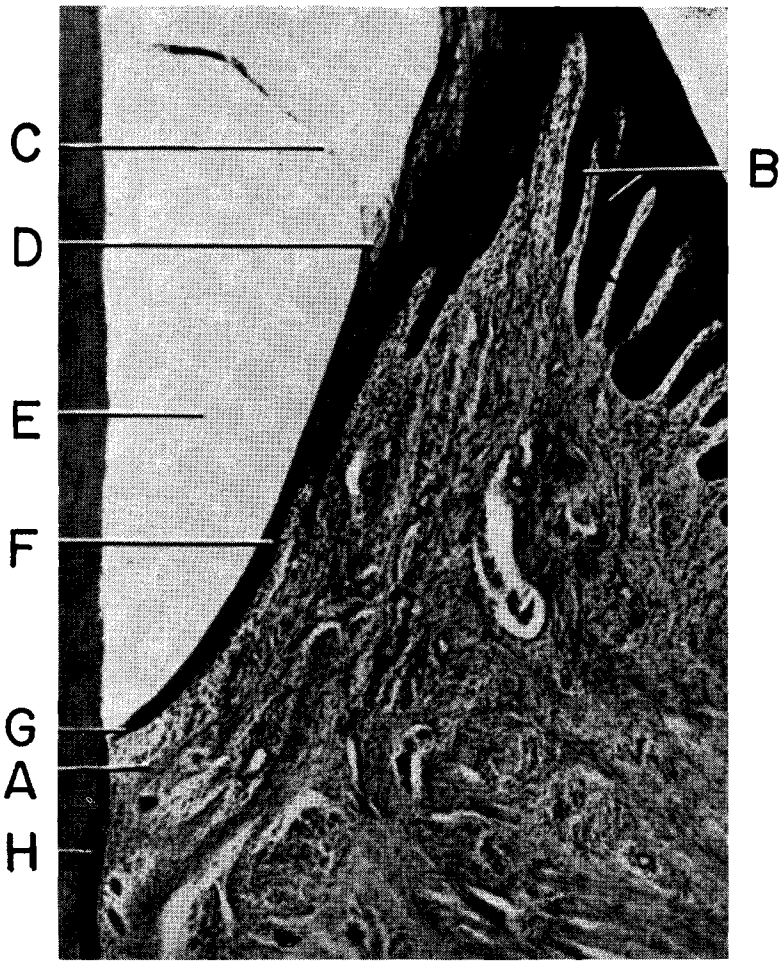

Figure 1. Supporting apparatus of the free gingiva. A, collagenous connective tissue fibers extending coronally from the cementum immediately below the cementoenamel junction; B, epithelial ridges of the free gingiva with which collagenous fibers from the cementum interdigitate; C, secondary cuticle; D, base of the gingival sulcus; E, enamel; F, epithelial attachment; G, cementoenamel junction; H, cementum. (Orban, B. *Oral Histology and Embryology*, 4th Edition. The C. V. Mosby Company. Fig. 188)

cementum immediately below the epithelial attachment are responsible for this gingival adaptation (Figure 1). Most of these gingival fibers radiate upward, laterally, or downward in several patterns to interdigitate with the ridges of the gingival epithelium[5,7] (Figures 2 and 3). Transseptal fibers, few in number, pass coronal to the alveolar crest to link adjacent teeth. In still fewer number, the

fibers of the "ligamentum circulare" increase the constriction of the free gingiva[1] (Figure 4).

The periodontal membrane, like the gingiva, is now realized to be more complex than it was thought to be. Whereas Gottlieb conceived of each collagen fiber bundle of the ligament as passing from an attachment in bone to an insertion in cementum, we can now discern a blending of alveolar, intermediate and dental fibers in this span. The intermediate zone of the ligament takes on significance as the site of continuous reformation of fiber linkages. It is possible now to see coexistent bone and cementum which form at different rates, and collagen fibers which continue to exist in spite of functional movement of the tooth.[20]

Frequently, where the dental apparatus is concerned, we seem to lose sight of the range of variation within the normal. The usual

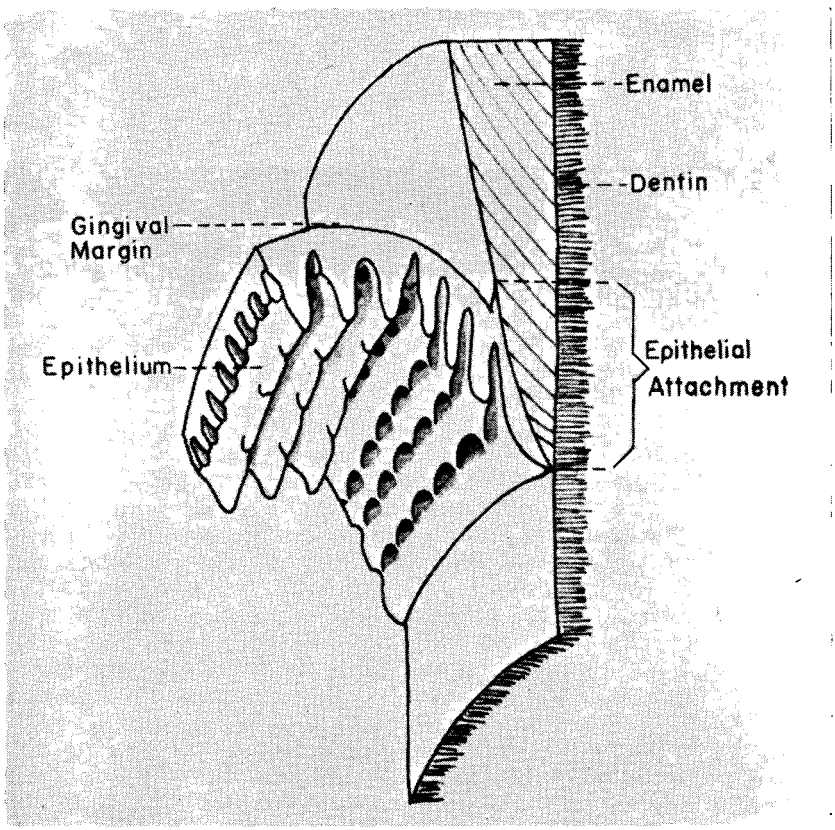

Figure 2. Epithelial ridges of the gingival epithelium. The "meshing" of these ridges with the gingival connective tissue fibers promotes tight gingival adaptation to the tooth surface. (Emslie, R. D. and Weinmann, J. P. "The Architectural Pattern of the Boundary Between Epithelium and Connective Tissue of the Gingiva in the Rhesus Monkey." *Anatomical Record* 105:35, October, 1949)

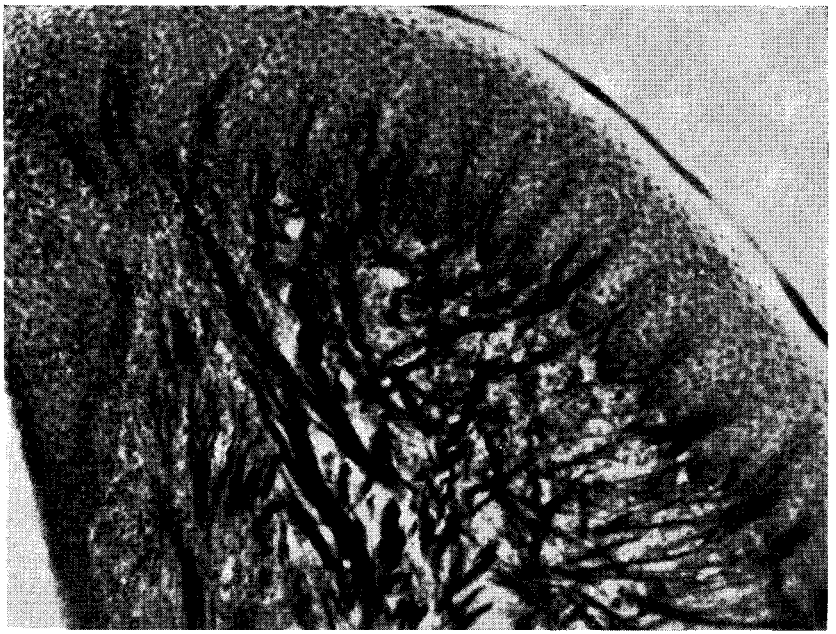

Figure 3. Interdigitation of the gingival fibers with the epithelial ridges of the free gingiva. (Goldman, H. M. and Cohen, D. W. *Periodontia*, 4th Edition. The C. V. Mosby Company. Fig. 17)

spatial relationships and dimensions of tooth, gingival margin and alveolar crest are well known. Similarly we can visualize without difficulty such basic surface landmarks of the periodontium as the free gingiva, the interdental papilla, the attached gingiva and the mucogingival junction.[18] At the same time, however, we may overlook the existence of highly significant variations in those features. The natural separation or the close approximation of two teeth, for example, may preclude an interdental papilla.[16] Delicacy of structure will characterize tooth, soft tissue and bone in one individual, while strength and bulk will be reflected in every feature of another mouth. Within a single arch the alveolar crest may be blunt and high on the facial surface of one tooth, while located as a paper-thin margin far apically on another (Figures 5 and 6). Hirschfeld,[10] Ritchey and Orban,[19] and Morris[13] have written of this normal variability. They have drawn attention to tooth crown convexity as it relates to width of the interdental septum, position of the cementoenamel junction on adjacent teeth, position of teeth relative to one another, and position of teeth upon their basal bone. In our daily consideration of patients, it should be remembered that those with a normal periodontium may actually demonstrate a far greater linear separation of alveolar crest and gingival margin on the facial surfaces of their teeth than is presumed, and that fenestration of the alveolar process over a tooth root is commonplace (Figures 7 and 8).

Tissue Reaction to Restorative Procedures

The tissues of the periodontium react to restorative procedures in a variety of ways. Where tissue health has prevailed prior to restorative treatment and the treatment involved minimal injury, local tissue health will continue. Where actual periodontal disease exists, good restorative treatment, combined with the periodontal, may fundamentally assist the return to normal of both the tooth and its environment. The addition, through restorative procedures, of further injury to an already diseased tissue complex, with the resultant extension of the disease is a third and more frequent outcome.

Classically, the supporting apparatus reacts to an irritant at the gingival margin or within the sulcus by the development of marginal gingivitis. The continued presence of the irritant or the concentration of several irritants may result in the inclusion of the deeper soft tissues and alveolar bone in the inflammatory process and hence the

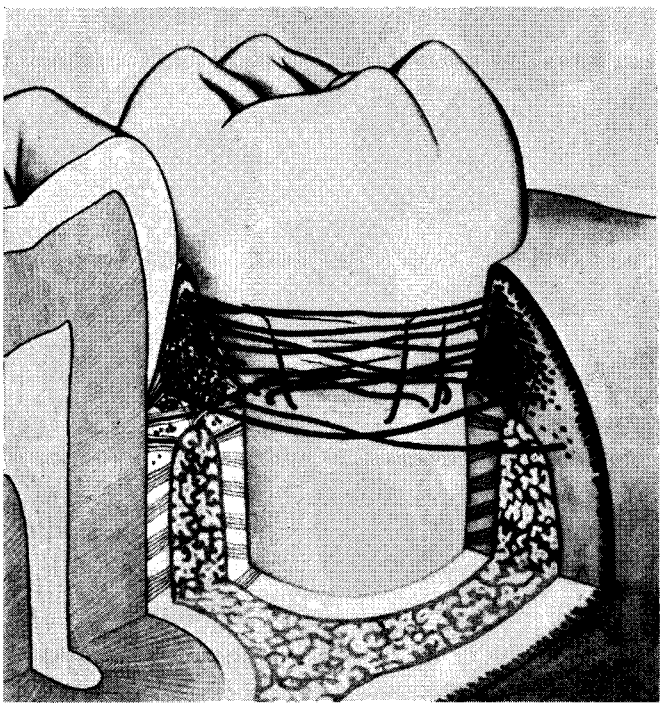

Figure 4. Circular fibers of the gingiva which strengthen the adaptation of the soft tissue to the tooth surface. The interdental papilla, as shown here, contains a blending of the circular and other gingival fibers. (Arnim, S. S. and Hagerman, D. A. "The Connective Tissue Fibers of the Marginal Gingiva." *Journal of the American Dental Association*, 47:271, September, 1953. Fig. 4)

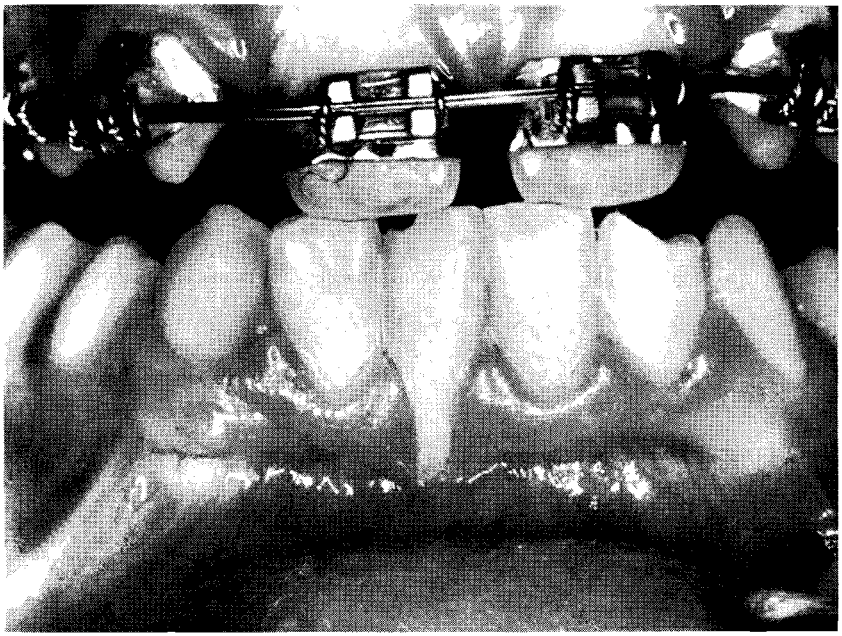

Figure 5.

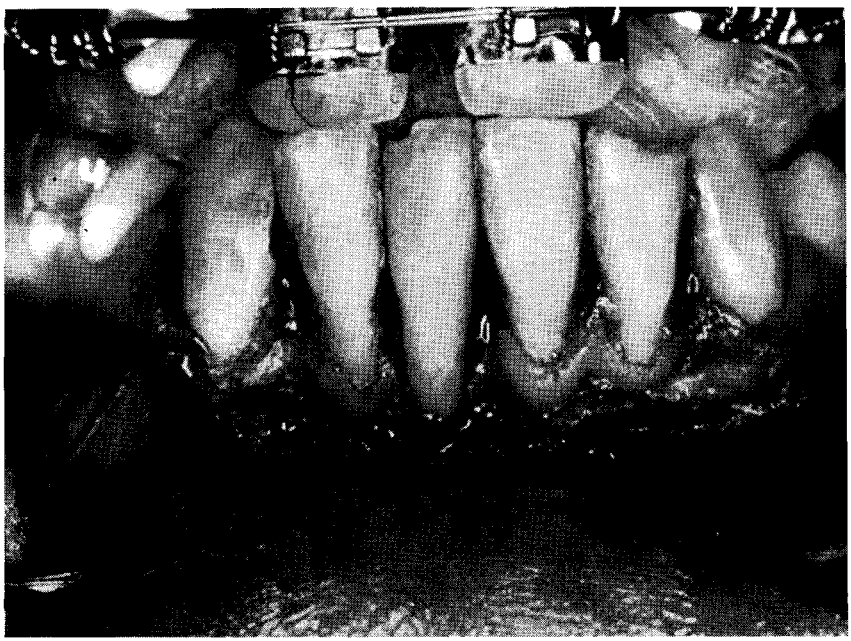

Figure 6.

establishment of the disease known as marginal periodontitis. Both marginal gingivitis and marginal periodontitis first develop, as a rule, interproximally. A variety of etiologic factors may and usually do prevail, but certain basic histopathologic features of the progression are almost always evident.

Perhaps the most significant early change occurring in gingivitis is the disruption of the gingival fiber apparatus and the resultant "falling away" of the gingiva from the tooth. Bacteria in number and variety gain access to the open crevice, and under their influence subgingival calculus often takes hold upon the tooth surface. Along the soft tissue wall of the gingival crevice microscopic ulcers develop as the inflammatory process in the underlying connective tissue destroys the cell bonding within the epithelial layer. The sulcus thus becomes a gingival pocket. Weakening of the marginal gingiva is further promoted by the proliferation of epithelial strands within its connective tissue. A fusion of these strands may occur, paving the way for vertical tears of the gingiva in the face of only moderate stress. A tight gingival cuff, essentially composed of collagen fibers, has given way to soft marginal tissue infiltrated with fluid, inflammatory cells and epithelial strands.[8]

Integrity of the cementum in the area immediately apical to the epithelial attachment cannot be maintained in this inflammatory environment.[12] Downgrowing epithelial attachment moves apically over cementum whose viable cementoblasts and gingival fibers have disappeared. We need not consider the details of the inflammatory extension into the alveolar crest other than to note that the advance is by way of the perivascular connective tissue[30] and usually leads to a crater-like resorption of the alveolar supporting bone. Destruction of the alveolar bone proper or lamina dura, therefore, is a secondary phase of bone involvement in marginal periodontitis. One condition must be assumed, however, in this regard. There must be absent from the adjacent periodontal membrane at the alveolar crest level either the incipient or the full-blown lesions of periodontal traumatism (occlusal traumatism).[11]

Repeated stress or a prolonged single stress upon the crown of a tooth may induce traumatism. The results of this condition include localized necrosis and thrombosis within the periodontal ligament and certainly death of cementoblasts at the affected site. Significantly, the marginal gingiva escapes involvement.[4,32] When the inflammatory process of periodontitis encroaches upon an area of traumatism, however, the infiltrate is believed to move first into the damaged tissue of the ligament rather than into the alveolar crest as it would otherwise do.[11] The result is a characteristic rapid proliferation of the epithelial attachment along the root surface and a general acceleration of the inflammatory damage. The characteristic lesion is one exhibiting vertical bone loss.

Figures 5 and 6. Marked variation between the levels of gingival margin and alveolar crest on the facial aspect of lower anterior teeth. Figure 6 reveals the alveolar crest as it appeared when first exposed during surgical treatment of the dehiscence on the facial aspect of the lower right central incisor. (Courtesy Dr. J. Alloy)

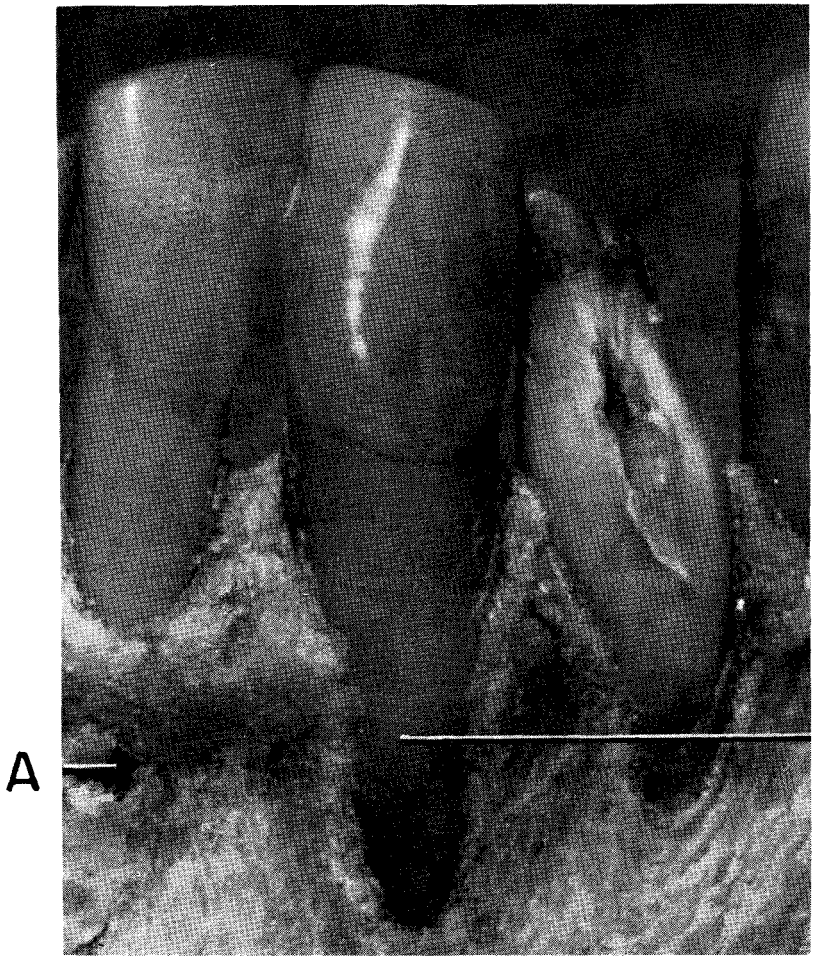

Figure 7. Commonly encountered variations in alveolar process anatomy reflecting tooth position and bone structure. A, penetration on the root of lower lateral incisor; B, absence of alveolar bone over a large area of root surface on the facial aspect of lower cuspid. Such bone patterns may be associated with normal gingival margin position and the absence of periodontal disease. (Courtesy Dr. S. Schluger)

Where teeth are to be restored, our interest of necessity must be directed to the restorative material, to the placement of the restoration and later to the aftereffects of both the placement and the final restoration upon the environment. The materials of restorative dentistry do influence the marginal gingiva when they contact it. This influence, however, is difficult of analysis and has not yet been adequately documented. Waerhaug has provided some evidence that heat cured acrylic resins per se are nonirritating to the

Figure 8. Important periodontal considerations relating to Class V cavity on maxillary right cuspid. The marked convexity of the cuspid root surface, the axial inclination of the root, and the apparent thinness of the alveolar bone point to the likelihood that the alveolar crest lies well above the gingival margin on the facial surface of the cuspid. Recession of the gingival margin following placement of a Class V restoration is a possibility because of these factors.

tissues of the gingival sulcus.[24] Similar neutrality of response to glazed porcelain and to gold foil is also suggested.[27,29] It has been Waerhaug's frequent observation that failure of gingival tissue to lie against a restoration without becoming inflamed stems more from the physical roughness of the surface or from marginal imperfections of fit than from contact with the substance itself. Almost without exception he has noted that marginal inperfections of restorations become the site of bacterial plaque development. Inflammation develops first opposite the plaque and later throughout the marginal gingiva[25,26,28] (Figure 9). Comparing bacterial accumulation on rough and smooth enamel surfaces in vitro, Swartz and Phillips drew conclusions which supplement these observations.[21] The problem extends, of course, into the realm of marginal penetration and percolation and to what degree these phenomena are permitted by different materials. Again, gold foil adaptation appears to be of a high order. As a result, where the foil restoration is concerned, there is a minimum of inflammatory response in the gingiva attributable to marginal penetration of bacteria or marginal percolation of fluid.

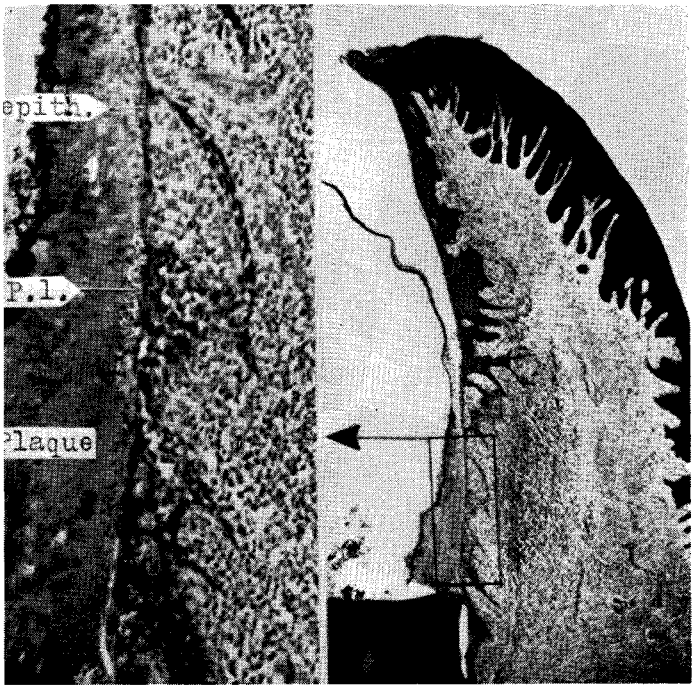

Figure 9. Inflammation of the gingiva directly associated with marginal imperfection in a zinc phosphate cement filling and the resultant bacterial plaque at the site of the marginal defect. Outlined zone in the low-power photomicrograph to the right is reproduced in greater magnification on the left. Marked inflammation of the connective tissue is evident opposite and above the gingival floor of the cavity. (Waerhaug, J. "Effect of Zinc Phosphate Cement Fillings on Gingival Tissues." *The Journal of Periodontology*, 27: 284, October, 1956. Fig. 6)

Class V Gold Foil

Actual placement of a dental restoration involves varying degrees of injury to the periodontium. Whether the injury will be sustained and not lead to secondary inflammatory breakdown of the gingiva is dependent in part upon the dentist. Let us take the Class V foil restoration as an example. Contraindications exist and active periodontal disease is one of these. If the decision is made to place the restoration in the face of existing marginal periodontitis or periodontal traumatism, these disease processes may be accelerated. Again, in the mere placement of the gingival clamp we have a situation fraught with dangers. Inherently these are related to the apical and proximal extension of the carious process. Often the epithelial attachment and the gingival fibers become involved. Thus caries extension or a too rigidly preconceived outline form may demand that the clamp enter the region of the gingival fibers.

If the bow of the clamp is extended almost to the level of the alveolar crest and the gingival margin of the foil is carried almost to the level of the bow, we have ignored the fact that a definite amount of tooth structure must be present above the alveolar crest for the insertion of gingival fibers. Wentz and Orban consider this minimum vertical separation of epithelial attachment and alveolar crest to be 1.06 mm.[33] Invasion of root surface essential to marginal fiber attachment can result in either proliferation of the gingiva or retraction of the gingiva with exposure of margins (Figure 10).

In the same way, gingival fiber detachment from cementum may occur when the outline form of the Class V cavity is extended proximally around the root curvature. Under this circumstance support of the interdental papilla as well as that of the marginal gingiva is involved. It may be impossible for the gingiva to resume its marginal contour or for the papilla to again tuck itself between adjacent teeth until its form protects both foil margin and gingival sulcus from the bacterial plaque (Figure 11).

The avoidance of permanent gingival failure around the foil restoration may lie in preoperative analysis of the periodontium

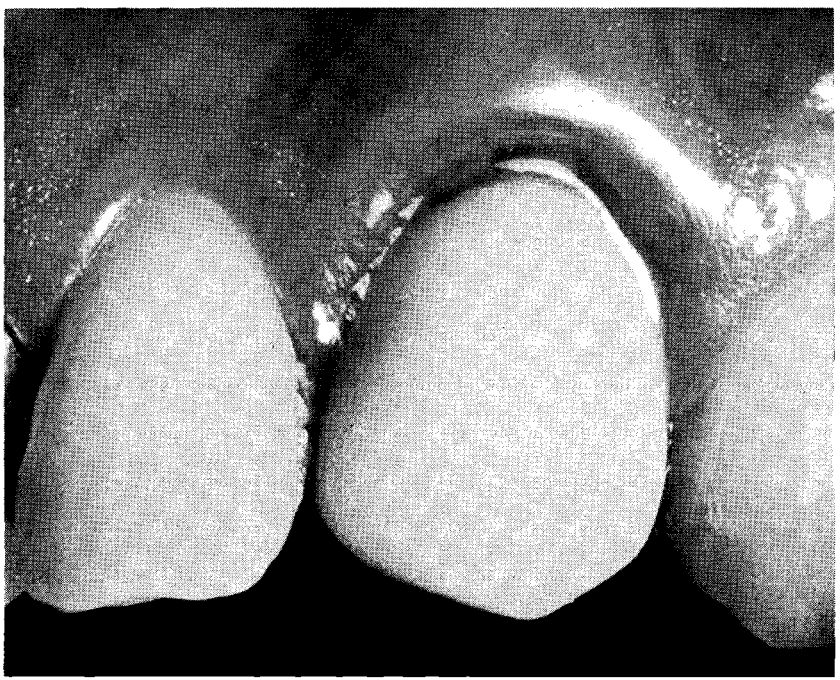

Figure 10. Failure of gingival adaptation following placement of full crown on upper left cuspid. This one-year postoperative result illustrates the type of lesion which may be established when the alveolar crest is near the gingival margin, and the critical zone of gingival fiber attachment on the cementum is invaded by repeated and faulty use of the gingival clamp.

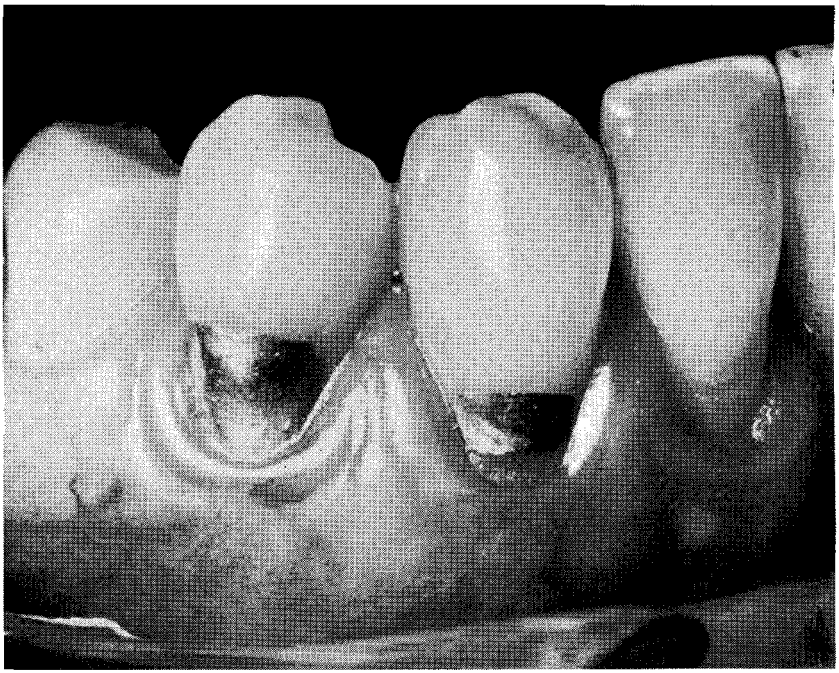

Figure 11. Failure of the gingiva to assume original marginal contour following placement of Class V foil restoration on lower right first bicuspid. Establishment of the desired outline form necessitated invasion of the facial and proximal root surfaces which originally provided gingival fiber support for the marginal gingiva and the interdental papillae. Insufficient attached gingiva is also a factor in this postoperative result. The gingival retraction on the cuspid is related more to imperfect contour of the foil than to root surface damage incurred during the finishing.

and prior periodontal treatment at the site. Occasionally, for example, we deal with a tooth where caries is found to extend apically in the cementum almost to the alveolar crest. There is no reason why localized mucogingival and, if necessary, osseous surgery cannot be employed initially to reposition the alveolar crest and establish an adequate zone for gingival fiber attachment (Figure 12).

The aftereffects of restorative treatment are many, and again we can find illustrations of them in the case of the Class V restoration. Just where the base of the sulcus will become re-established will depend to a degree on the condition of the root surface apical to the foil margin. A "ditched" root surface will encourage the adherence of bacteria and the rapid production of a plaque, if not of calculus.[34] Since tight epithelial contact with a surface covered by plaque or calculus is not to be expected, epithelial attachment as such must begin apical to the roughened surface. Where the epithelial attachment will terminate apically will depend in part upon the location of the remaining intact gingival fibers. Such attached fibers halt

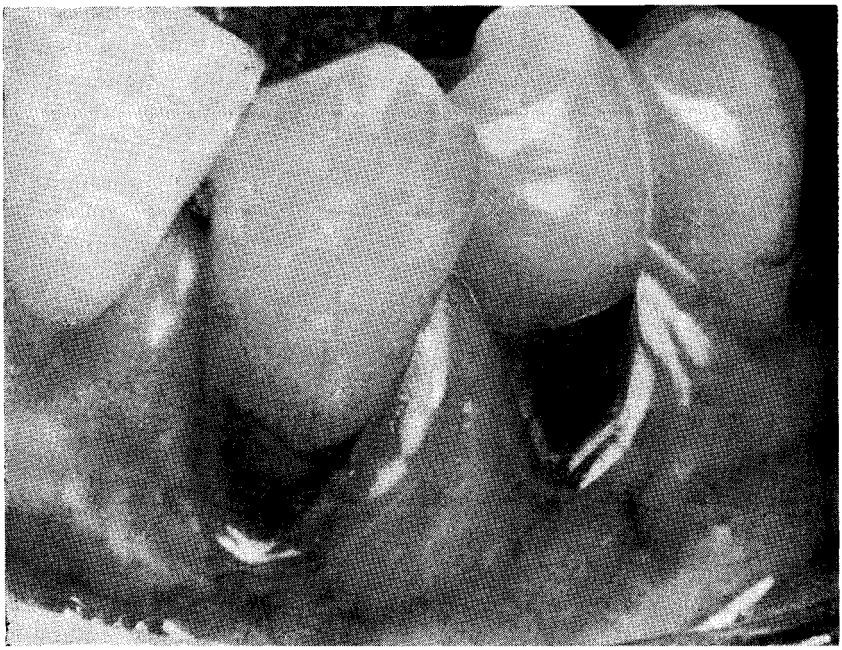

Figure 12. Unsatisfactory periodontal result following placement of Class V foil restoration on lower left first bicuspid. More thorough preoperative assessment of the mucosa facial to both first bicuspid and cuspid would have revealed the need for a wider zone of attached gingiva. Preliminary periodontal surgery in the form of the "attached gingiva extension" procedure may be indicated in such an instance. Otherwise, trauma associated with use of the gingival clamp and the actual placement of the restoration may, as in this case, destroy a pre-existing attached gingiva of minimal width.

epithelial extension. After dam and clamp have been removed, living cementum and attached gingival fibers may be absent, because of operative injury, from the zone immediately apical to the preoperative epithelial attachment. A race develops between the gingival epithelium migrating apically and the connective tissue seeking to create new cementum and new fiber attachment on the root surface. It is probable that epithelium is usually the winner under the circumstances which prevail. Damage to a root surface, therefore, increases the likelihood of reduced connective tissue support for the marginal gingiva and also of a premature advance of the epithelial attachment.

Summary

We have indicated how the successful application of restorative procedures has come to mean the recognition of factors which are readily ignored. These factors deserve summation.

1. The preservation or re-establishment by prior periodontal treatment of the healthy marginal gingiva.

2. Cognizance of the normal variations which exist in the form and positioning of the tooth, gingiva and alveolar bone.

3. The modification of outline form to accommodate both the epithelial attachment and the gingival fiber apparatus between the floor of the preparation and the crest of the alveolar bone.

4. The occasional need and the feasibility of using periodontal surgery to modify the total periodontal environment, as a preliminary to the single-tooth restoration.

5. The primary importance of marginal adaptation, surface contour and surface finish in a restoration if gingival disease is to be avoided.

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TECHNICAL PROCEDURES IN GOLD FOIL AND THEIR RELATION TO PERIODONTIA*

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In introducing the subject matter of this paper, I am somewhat at a loss to know whether I should defend the use of gold foil as it relates to the problems of the periodontist or whether I should testify as to the excellent results obtained by its use in the prevention of periodontal problems.

Since dentistry is concerned with the control and prevention of dental disease, which primarily consists of dental caries and periodontal lesions, we as dentists are charged with the repair of diseased dental tissue when prevention has failed. Masterfully effected restorative dentistry constitutes one of the great factors of prevention.

Dr. W. I. Ferrier, in a paper read before the National Dental Association at its 22nd Annual Session in Chicago, Illinois, in 1918, made the following statement:

"Dental disease may be divided into two general classes; those affecting the hard tissues of the mouth, and those affecting the soft tissues. They are so co-related, so inter-dependent, that if decay, the most prevalent of the diseases of the hard tissue, is present in the human mouth, then as a rule, inflammation of the soft tissue ranging from simple gingivitis to pyorrhea alveolaris is also present. If the one is permitted to progress without interference, the other proportionately progresses."

Through long observation substantiated by discussions with other observers, it is the author's firm belief that the operator adept in the use of gold foil is invariably an expert in all other operative procedures. It is a matter of common knowledge in the Pacific Northwest, where there are many gold foil study clubs, that men entering a gold foil study club and receiving adequate and ample instruction in cavity preparation and the application of gold foil very quickly improve their cavity procedures for *all* types of restorations. It has been very interesting to note the improvement in inlay margins and in the contours, margins and polished alloy restorations of the finished cases produced by men after their participation in gold foil study clubs. So it is almost axiomatic that a good gold foil operator is a good dentist.

When Dr. G. V. Black gave us a technic whereby we might not only restore lost tooth structure, but restore it in such a manner that those surfaces operated upon would remain immune to further decay, the soft tissues would be protected from injury, and the

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tooth once more would become useful and efficient. He had found that gold foil not only theoretically but clinically most nearly fulfilled the requirements of making an ideal operation.

It is from the standpoint of the prevention of dental disorder that I shall discuss some of the details in the insertion of gold foil restorations. I know of no scientific knowledge that will substantiate or contradict some of the statements that I shall make, but a careful study of operative procedures done by a group of men, all with over forty years of operating experience, prompts me to believe that the proper and correct use of the rubber dam, separators and clamps is in no way damaging to the soft or supporting tissues of the teeth, and that correct restoration of contours on proximal surfaces and on labial and buccal eroded or decayed areas is a positive and definite asset to the health of the supporting tissue.

Almost any of the instruments or aids we use in dental restorations, if used improperly, can develop into lethal weapons, so to speak. Harmless as a piece of rubber may be, if used as a tight rubber band around a tooth and if left on that tooth, it may cause exfoliation of the tooth.

The ligature, as indispensable as it is in our practice, may do untold damage if tied tightly around the gingival area of a tooth. A separator, if used improperly, is nothing less than an instrument of torture. However, with *proper* care in their use these many accessories may serve as valuable aids to our technics.

Let me discuss some of these accessories individually and point out that their proper use can do little or no damage to the tooth or its supporting structures in contrast to the varying degrees of damage that can result from their improper or careless use.

Ligatures and the Rubber Dam

In the application of the rubber dam, care should be used in punching the holes for the teeth so that sufficient rubber is left between the holes to insure full coverage of the interseptal soft tissue. This procedure can be done only by careful examination of the interproximal spaces in the area to be included. By necessity the spacing of the holes will vary according to the shape of the teeth, the relative position of the teeth to each other, and the presence of wide or very narrow interproximal areas. If too much rubber is left between the holes, it, of course, does not retract the gingival soft tissue, and the bulk of the material interferes with the restorative procedures. On the other hand, if insufficient rubber is left between the holes, it invariably pulls only to one tooth, allowing the soft interproximal tissue to extrude from under the dam. In a very few minutes this tissue becomes strangulated and, if it is held in that position during the length of the operation, sloughing and deterioration will follow.

The use of ligatures in the application of the rubber dam is only to assist in passing the rubber between the teeth, *never* to secure

the rubber around the gingival of the tooth. With the assistance of a small burnisher and a light stream of air to dry the teeth, the operator can invert the rubber around the gingival of each tooth. The entire operating field will remain dry throughout the operation without any damage whatsoever to the soft tissues. It is truly a cardinal sin to tie a tight ligature around the gingival area of a tooth. Invariably, where this procedure is followed, the damage to the soft tissues is immeasurable.

Clamps

Clamps are an invaluable aid in the application of the rubber dam and in isolating the field for Class V cavities; however, when improperly used, they can do great damage.

In all but the rarest situations, the rubber dam clamp, when used to assist in placing the rubber dam, can, and should be removed as soon as the dam has been placed. A small triangular piece of dam can be clipped from the corner below the chin and, when stretched, will nearly always slip through the contact distal to the posterior exposed tooth. When released, it is seldom, if ever, that the rubber dam will pull out of the contact. Where the clamp is placed on the last posterior remaining tooth in the arch, a bit of compound may be applied to the tooth to extend over the distoocclusal surface. The clamp may then be removed and the compound retains the position of the dam. The patient appreciates the removal of this clamp, and I am sure that if the tooth upon which the clamp was placed and the gingival tissue surrounding that tooth could talk, they would be loud in praise of the operator who is thoughtful enough to follow such a procedure. Due to the shape of a tooth, clamps will very often creep or slip gingivally; this is not only a painful sensation, but certainly a damaging error in their use.

In the placement of the Ferrier No. 212 clamp, the lingual jaw should always be held well up on the crown of the tooth, never allowed to slip or be secured at the gingival level. The labial or buccal jaw must be placed gingivally to the area to be operated on, and while in this position, the clamp is well secured with compound to as many teeth as the operator finds necessary to insure immobility. When greater protection for the tooth to be operated on is felt necessary, compound can be placed solidly across the lingual area, thus securing the tooth in a solid block with four or more additional teeth. This method is particularly indicated on large Class V restorations and on teeth that have *slight* periodontal involvement. With this procedure, any stress or strain exerted upon the operated tooth is minimized and distributed over the whole area that is blocked.

There are times when decay or, more often, erosion has occurred so far gingivally that seating a clamp to include the entire area becomes very difficult. Several technics have been offered for resecting or cutting the gingival tissue to facilitate the placing of the clamp. I have yet to find this radical procedure necessary. If

a case presents where it seems almost impossible to secure the clamp far enough gingivally, I have found that it is not difficult to secure the clamp short of the desired gingival area and proceed with the cavity preparation. After the clamp has been retained in this position for a few minutes, the tight gingival tissue has responded to the stretching effect that it has been subjected to, and it becomes a very simple procedure to remove and reset the clamp to the desired position. I have seen this method used many times, and where care has been used, the operation has been completed without any laceration of tissue. In a very short time the tissue returns to a normal, healthy appearance. The comparable results of these various technics, as viewed by a periodontist, will not be discussed in this paper.

In closing this discussion, it should be noted that the jaws of a clamp should not be really sharp, and when designed for use on cementum, the jaws should be dull or blunt. The spring or temper should also be removed from these gingival clamps to prevent scarring or heavy tension on the cementum. It might also be noted that the careful operator will very frequently reshape and grind the jaws of most clamps. The jaws of new clamps are too sharp and should be reduced to a blunt edge. Any gingival clamp should be well secured to prevent movement, for a loose clamp will cause severe damage to the cementum.

Separators

In the hands of the overeager, the unskilled or the uninformed, the separator can be an instrument of torture, as well as a source of damage that may contribute to the development of periodontal conditions. However, when properly used, it should not in any way be harmful to the soft or supporting tooth structures.

It is an instrument used primarily for two purposes: first, to stabilize the tooth to be operated on, distributing the malleting stress over the several teeth involved in the separation; and, second, to gain access in a small degree, allowing for the finishing of the proximal surface and contact point of the tooth.

In placing a separator, it should be adjusted to the correct position and tightened only sufficiently to hold it in place. It should then be blocked with compound to prevent it from creeping gingivally as it is tightened. Minimum separation should be obtained, always remembering that the initial tightening causes the separating bows to spring, and the separation of the teeth follows gradually as the spring of the bows is released by the movement of the teeth. Thus separation is produced very slowly and very gradually in contrast to that of the case where wide separation is obtained by heavy pressure applied quickly and the continuing separation from the spring of the bows follows.

If the first procedure is used, only minimum separation results. If the second procedure is used, the desired separation is obtained at once, but the separation that follows is far in excess of the necessary