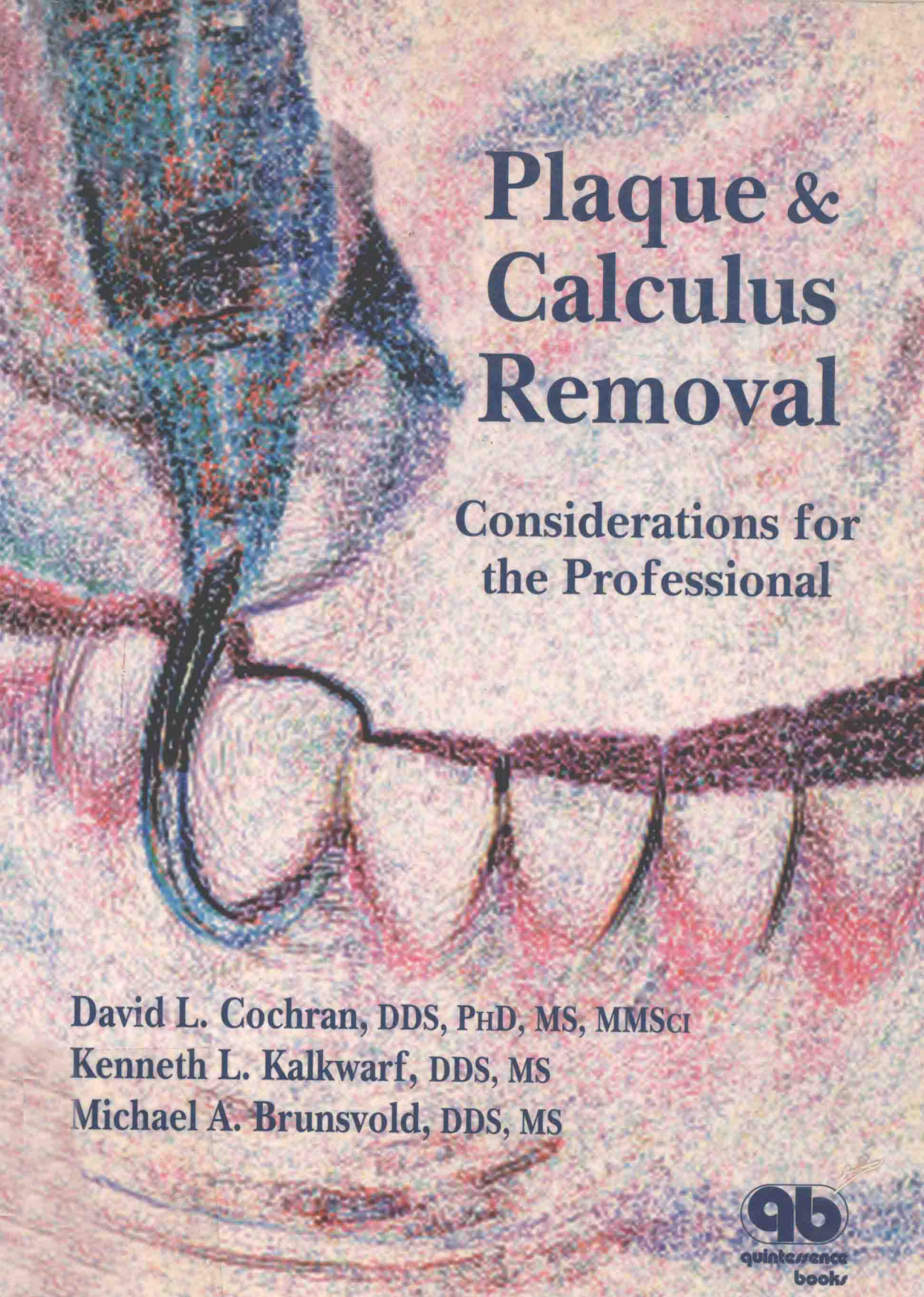

Plaque & Calculus Removal

Considerations for the Professional

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Preface

This book addresses the removal of plaque and calculus from teeth and implants, presenting procedures for both the patient and the professional to perform. Special consideration is given to the removal of plaque and calculus around endosseous dental implants.

This book is written primarily to assist the general dentist and hygienist in understanding various consequences of plaque accumulation and what is required to remove plaque and its calcified product, calculus. It is not intended to be a comprehensive review of plaque and calculus nor to describe specific mechanical aspects of removal techniques. Several excellent texts and manuals on each of these topics already exist. This book should provide supplemental material to the more detailed texts and help the reader assimilate various considerations for plaque and calculus removal.

An overview of the significance of plaque and calculus formation is given as is the biologic rationale for their removal. It is important to note that plaque is recognized as the etiologic agent for gingivitis and that it is a necessary,

but not always sufficient, etiologic agent for periodontitis. Other factors play a role in the loss of connective tissue and clearly many of these factors involve the host response. This book does not contain in-depth discussions of these etiologic aspects of periodontal diseases or the potential pathogenetic aspects of the diseases. The reader is referred to texts on periodontal diseases for this information.

Many studies conclude that the critical component for successful periodontal therapy lies in the maintenance of a relatively plaque-free environment. Furthermore, long-term studies have shown that the specific type of periodontal therapy administered is not critical if good plaque control is consistently obtained. Because it is absolutely essential that the patient with periodontal disease removes plaque daily, this book provides a discussion on techniques for plaque removal by patients. Specific procedures are described, as are the advantages and disadvantages of some currently available products touted for daily plaque removal.

Information is also provided on the removal of plaque and calculus by the dental professional, including both traditional mechanical and electronically assisted procedures. Many practitioners have developed variations on specific techniques, several of which are discussed. Specific adjuncts that are helpful in the removal of plaque and calculus are also presented, in addition to procedures used to properly maintain hand instruments.

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Rationale for Plaque and Calculus Removal

Plaque

Significance of Plaque

The periodontal diseases can be classified into two broad categories: gingivitis and periodontitis. Gingivitis is defined as inflammation of the gingiva and is a reversible condition. Many forms of periodontitis probably exist but the definition of this disease can be considered as inflammation of the periodontal tissues and loss of connective tissue.[1] The etiologic agent for gingivitis was examined in the classic work by Löe et al.[2] In these longitudinal studies, dental students were examined and their teeth cleaned so that the gingival tissues were as plaque-free as possible and non-inflamed, ie, pink, healthy, had normal contours and did not bleed following gingival probing (Fig 1-1). At that time all oral hygiene procedures were discontinued and plaque was allowed to accumulate for up to 4 weeks. Gingivitis

developed within 21 days in all subjects (Fig 1-2). The subjects then underwent a professional tooth cleaning and oral hygiene procedures were instituted. Within 14 days after plaque removal, all gingival tissues returned to a healthy state. This experiment has been repeated a number of times, always with the same result. Thus, a very strong cause-and-effect relationship is known for plaque accumulation and the development of gingivitis (Figs 1-3 and 1-4). The relationship between plaque accumulation and gingivitis provides the foundation for plaque removal procedures by the professional and by the patient as the primary procedure to prevent or treat gingivitis.

Much less is known about the etiologic factors of periodontitis. It appears that plaque is required for disease initiation, but it alone is not sufficient to cause the disease. An epidemiologic study of periodontitis in a population of individuals who had never been exposed to dental care was performed by Löe et al.[3] The results showed that approximately 8% of the population had very severe periodontitis while 81% had moderate periodontitis. The most surprising finding was that approximately 11% of the population, despite very large amounts of plaque and calculus, did not show signs of periodontitis. This study demonstrates that plaque alone is not sufficient to cause periodontitis. It is now apparent that the interaction between host response and plaque is critical for the initiation and progression of periodontitis. It is obvious from these studies, however, that plaque is required for the initiation of the periodontal diseases. Thus, preventive therapies for periodontal diseases should always include the removal of plaque.

Fig 1-1. Facial view of maxillary and mandibular teeth showing normal contours, noninflamed gingiva, and pink, healthy tissues.

Fig 1-2. Lingual view of left maxillary posterior teeth and gingiva. Marginal and interproximal tissue is red, swollen, and severely inflamed, indicative of gingivitis.

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Fig 1-3. Anterior view of periodontally involved teeth stained with disclosing solution. The plaque is visualized as red stain.

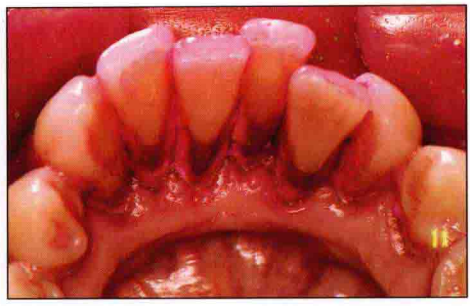

Fig 1-4. Lingual view of mandibular anterior teeth. Plaque is stained red with disclosing solution. Calculus is observed on the interproximal surfaces below the cementoenamel junctions.

Plaque Formation

The formation of dental plaque begins with the deposition of an organic layer called the dental pellicle on the tooth surface. The thickness of the pellicle usually ranges from 1 to 2 μm and forms within a couple hours on a cleaned tooth surface. Grant, Stern, and Listgarten[4] have described deposition of the pellicle in four stages: *1)* bathing of the tooth surfaces by salivary fluids, which contain numerous protein constituents; *2)* selective adsorption of certain negatively and positively charged glycoproteins; *3)* surface denaturation and acid precipitation resulting in loss of solubility of the adsorbed proteins; and *4)* alteration of the glycoproteins by enzymes from bacteria and the oral secretions. Once formed, the dental pellicle is actively involved in bacterial colonization. Protein-protein and protein-carbohydrate interactions occur and provide receptors for adhesions or other binding proteins. Specific proteins present in the pellicle then selectively bind certain bacterial species. After the initial layer of bacteria attaches to the pellicle, many different bacterial species rapidly accumulate and the composition of the bacterial flora begins to change. As maturation of the plaque

occurs, salivary components continue to play a role. Proteins and adherence factors bind to the developing matrix and intercellular bacterial adhesion occurs.

Bacterial Composition

The composition of dental plaque varies among individuals and is dependent on the specific tooth surface. The appearance is definite, with bacterial cells arranged as colonies in clumps or columns. Various gram-positive species, including streptococci, form a predominant part of the newly formed supragingival deposit. As plaque matures, facultative microorganisms proliferate, creating an environment with low oxygen tension and the growth of anaerobic microorganisms. In subgingival areas, motile, gram-negative rods and spirochetes predominate. These bacteria are often arranged in zones or layers with adherent layers near the tooth surface and more loosely arranged layers closer to the tissue. Studies on the bacterial composition of healthy and diseased gingiva have now been documented. Coccoid and short rod forms are associated with healthy gingiva. Distinctly different bacterial floras are associated with different forms of periodontitis.

Dental Stains

Staining of adherent tooth deposits can range from light to severe and take on a variety of forms. The staining constitutes an esthetic problem but contributes little to the pathogenesis of disease. Food stains by various pigments such as those in tea and coffee, as well as by tobacco tar, make up a large part of the stain normally encountered. Staining by bacteria also occurs and can range from brown and black to green and orange. Recently, brown staining by antimicrobial

mouth-rinses has been commonly found. Staining from this source can become so prominent that compliance with use of the antimicrobial mouthwash is precluded.

Plaque Removal

As previously noted, dental plaque is associated with both gingivitis and periodontitis. Plaque removal thus constitutes an essential component of the therapeutic approach to preventing and controlling these diseases. Plaque removal can be accomplished by the professional, the patient, or both. After a tooth surface has been cleaned and the plaque removed, new dental pellicle is deposited very rapidly (within minutes to hours). Frequent removal of plaque results in the occurrence of less mature forms of dental plaque, which contain fewer numbers of the potentially pathogenic bacterial colonies. Subgingival bacteria are also affected by daily supragingival plaque control. Thus, effective removal of plaque is a desirable goal for the prevention of the periodontal diseases. Plaque accumulation occurs predominantly in areas protected against friction from food, cheeks, tongue, and lips. Prime locations for plaque deposits are at the gingival margin and in the gingival crevice. Many studies indicate that plaque removal by both the professional and the patient at very frequent intervals is the most effective way to control periodontal diseases.

Calculus

While plaque and the bacteria associated with plaque have been implicated as the primary etiologic agents for gingivitis and periodontitis, maturation and calcification of plaque into dental calculus is also a primary concern for the dental thera-

pist. Calculus deposits harbor bacteria from the patient's mechanical and chemical cleansing approaches[5] and provide an environment conducive to continued bacterial growth. Removal of calculus deposits should be a primary goal for the therapist involved in treating periodontal diseases.

Exposure of bacterial plaque to tissue fluid (saliva or crevicular fluid) will result in mineralization of the plaque and formation of calculus. Calculus deposits are classified according to their physical location. Supragingival calculus attaches to the tooth's surface coronal to the gingival margin and subgingival calculus forms apical to the gingival margin. Supragingival calculus is usually chalky in appearance and relatively easy to remove compared to the dark brown or black subgingival calculus deposits. Removal of both types of calculus eliminates the nidus of resident bacteria in the calculus mass and allows the patient access for removal of bacterial plaque from the tooth's surface.

Scaling/Root Planing

Scaling is defined as the removal of calculus from the surfaces of teeth, while *root planing* may be described as smoothing of the root surfaces.[1] Root planing includes the removal of rough cementum or dentin that is impregnated with calculus (Fig 1-5). Scaling and root planing are usually performed together as a therapeutic approach for gingivitis and periodontitis.

Traditionally, the end points of scaling/root planing have been the inability of the clinician to mechanically or visibly detect remaining calculus and the perception of a smooth root surface. Obviously, these end points are subjective.

Numerous studies have confirmed the inability of clinicians to remove subgingival calculus deposits with traditional scaling and root planing procedures (Fig 1-6).[6] However, in many cases, a positive healing response of the periodon-

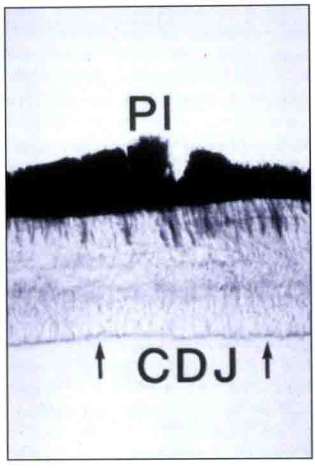

Fig 1-5. Micrograph demonstrating plaque penetrating into the superficial layers of cementum on the tooth root. CDJ and arrows represent the cementodentinal junction; PI, plaque.

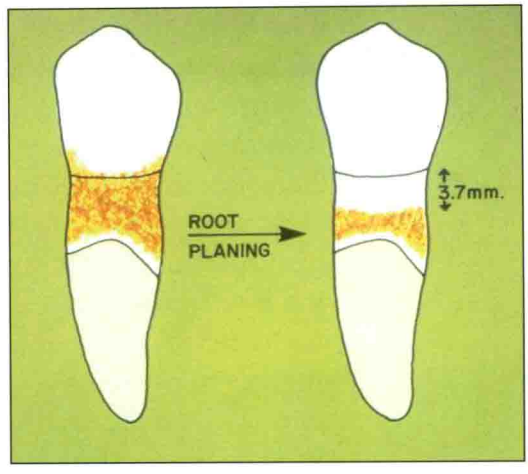

Fig 1-6. Shown is the area of the tooth root accessible to closed root planing procedures.

tium occurs despite the fact that calculus deposits undoubtedly remain.[7] Robertson[8] probably best explains the situation when he states, "while total elimination of etiologic factors is the appropriate treatment goal, reduction of plaque and calculus below the threshold level that is acceptable to the host appears to control the infection process and improve the clinical signs of inflammation."

Based on this hypothesis, the therapeutic end points for scaling/root planing should not be the inability to detect calculus deposits or the perception of a smooth root surface. The clinician must instead evaluate the healing response of the periodontal tissues following completion of therapy. If tissue healing progresses to completion with no remaining signs of inflammation, one has achieved a successful end point. If signs of inflammation remain, additional treatment is indicated.

Closed/Open Scaling and Root Planing

Many approaches have been advocated for the removal of calculus from the tooth surface. Each approach will be described in more detail later in this text. Supragingival approaches are all relatively straightforward unless gingival contours are unusual (Figs 1-7 and 1-8), with the deposits visibly identified and removal procedures easily controlled. The response of the marginal tissues during healing after treatment is easily evaluated.

Appropriate methods to remove subgingival calculus are much more controversial. The primary discussions revolve around the appropriate type of instrument (hand/mechanical vs powered) and whether the procedure should be accomplished with a closed approach (inserting the instrument into the gingival crevice and working by tactile sense) or with an open approach where the gingival tissue is surgically reflected, allowing instrumentation and evaluation with direct visual guidance.

A closed approach is advantageous in that it is not as time-consuming (it does not require tissue incision, tissue reflection, suturing, and subsequent postsurgical follow-up).

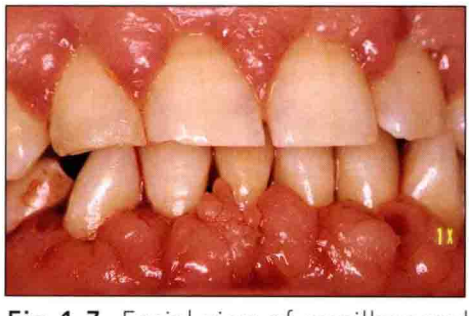

Fig 1-7. Facial view of maxillary and mandibular anterior teeth of a patient taking cyclosporin.

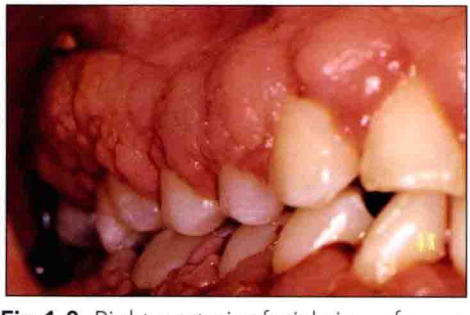

Fig 1-8. Right posterior facial view of same patient as seen in Fig 1-7 demonstrating the extreme gingival contours that can occur in certain patients taking particular medications. These contours complicate plaque removal procedures.

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