fifth edition

Primary Preventive Dentistry

Norman O. Harris

Franklin García-Godoy

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PREFACE

The useful lifetime of much knowledge is finite. As new discoveries, or as old diseases are gradually conquered, new priorities emerge. Because textbooks are a major source of information used in the education of health professionals, it is imperative that they be as current as possible.

The first four editions of this text chronicled the great number of changes in preventive dentistry between 1978 and 1994; this fifth edition updates that information to 1998. One of the most troublesome problems with each successive edition has been the need to drop many older references to find space for the new. Every effort has been made to retain citations from past landmark research that is still the basis for today's laboratory and clinical achievements. Extensive revisions have been made throughout the book to reflect the increasing emphasis on school dental health and health promotion, nutrition, and the clinical application of primary preventive dentistry procedures to control the plaque diseases. A short epilogue on "The Ethics of Prevention" has been added. Thirty-five authors and co-authors from 22 teaching institutions have participated in the rewriting of the chapters to help ensure inclusion of the most current knowledge. American, Canadian, English, German, Korean, South African, and Swedish writers are presented among the authors, reflecting the rich contributions to preventive dentistry from throughout the world.

Although the facts contained in this edition have been greatly upgraded, the format of presentation remains the same as in previous editions. The text is written in an easy, narrative style that facilitates learning. Each chapter begins with a list of learning objectives, is followed by embedded and self-evaluation questions, and includes an extensive list of references. With these elements, a teacher can develop mastery learning or remedial programs, and the student can continually monitor progress. In short, the authors have earnestly striven to produce a "user-friendly," instructive, and up-to-date book for the student and the dental health professional. We hope we fulfilled the words of Amos Bronson Alcot: "That is a good book which is opened with expectations, and closed with delight and profit."

■ ACKNOWLEDGMENTS

In 1978 Dr. Arden Christen as a coeditor, helped develop the first edition of this textbook to focus entirely on primary preventive dentistry. It was to be a textbook to (1) include outstanding authors and co-authors from various dental research, public health agencies, and teaching institutions in the United States and overseas; (2) be written for students and not for colleagues; (3) feature embedded questions for student self-study; and (4) contain objectives, italicized text, and chapter summaries to let the student know what the authors considered important.

Dr. Christen is now leaving as coeditor. The legacy of his contributions to primary preventive dentistry will continue to dwell in the minds of the many thousands of students who have used this book over the past two decades.

Also, lest we forget, no dental text can be assembled without the contributions of many known and unknown individuals. Since the first edition, a total of 55 authors, both foreign and domestic have contributed their expertise to the five editions. The numerous photographs, articles in the dental literature, and suggestions by colleagues and students have similarly helped to improve the book over time. Equally important is the fact that every book that is published is a much better tome due to the intercession of copy and book editors employed by the publishing company to insure correctness of grammar, format, and spelling. Finally, I would be greatly derelict in my appreciation if I did not acknowledge the tremendous support by Dr. García-Godoy's wife Katherine, and my wife Gracie during the long months of manuscript preparation for publication.

In summary, to Dr. Christen and to all of those individuals with whom I have worked and depended on so much over the past 19 years, I owe a heartfelt thanks. Thank you!

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1

INTRODUCTION TO PRIMARY PREVENTIVE DENTISTRY

NORMAN O. HARRIS

OBJECTIVES

At the end of this chapter, it will be possible to

1. Define the following key terms—**health, primary prevention, secondary prevention,** and **tertiary prevention**—and provide specific examples of each.
2. Name four convenient categories that aid in classifying dental disease and in planning oral disease prevention and treatment programs.
3. Name five general approaches to the prevention of dental caries and/or periodontal disease.
4. Cite two **early** actions that are essential for arresting the **progression** of disease once primary preventive measures have failed.
5. Explain how the planned application of current preventive dentistry concepts and practices, including use of sealants and remineralization therapy, when coupled with **early detection** and **immediate treatment** of the plaque diseases, **can result in a zero** or **near-zero annual extraction rate.**

INTRODUCTION

It is the goal of the dental profession to help individuals achieve and maintain maximum oral health throughout their lives. Success in attaining this objective is highlighted by the decline of caries throughout the Western world,[1] and the dramatic reduction of tooth loss among adults in the United States.[2] This progress has been mainly due to the use of

water fluoridation and fluoride-containing products, and the growing acceptance of primary preventive care.[3]

Untold millions of research hours and money have been invested in reaching our present capability to control the ravages of the plaque diseases.[a] Effective strategies that can markedly reduce the number of carious teeth and periodontal disease are *now* available. *They only need to be used.*

All health professions recognize the need to emphasize that patients should seek entry into well-planned preventive programs. For dentistry, lack of prevention results in more restorations, periodontal treatment, extractions, and dentures for many individuals. The changeover in priority from *treatment* to *prevention* will require active leadership and health promotion[b] by the dental profession, consumer advocates, public health educators, and health policy planners. Public health delivery systems, such as the military and industrial organizations that provide benefits to their personnel, have usually been in the forefront of such change because of the economic advantages accruing to the provider and health benefits to the recipients. For example, in 1989, a report by Malvitz and Broderick[4] recounted the results following the change of focus toward a maximum emphasis on prevention for dental services by the Indian Health Service in the Oklahoma City area. The total number of visits *increased* by 10 percent, yet the number of dental personnel *remained constant.* The percentage of preventive services *increased,* but the number of restorative procedures concomitantly *decreased.* ■

BENEFITS OF PRIMARY PREVENTIVE DENTISTRY TO THE PATIENT

For the patient who thinks in terms of economic benefits, prevention pays. If preventive programs are started early enough by the patient (or, preferably, by the parents of young children) long-range freedom from the plaque diseases is possible—a sound cost–benefit investment. After all, the teeth are needed over a lifetime for *eating,* and *speech* is greatly improved by the presence of teeth. A pleasant smile greatly enhances *personality expression.* Teeth also contribute to *good nutrition* for all ages. An absence of teeth or presence of poor teeth often results in a *loss of self-esteem* and *minimizes employment* possibilities when continued public contact is required.

[a]The plaque diseases are *caries* and *periodontal disease; both* are due to the presence of a pathogenic dental plaque on the tooth surface.

[b]Health promotion can be defined as "the process of advocating health to enhance the probability that personal, private, and public support of positive health practices will be a social norm."

BENEFITS TO THE DENTIST

Possibly the first benefit of preventive dentistry is the fulfillment of the moral commitment to the Hippocratic oath that is taken by health professionals at graduation "to render help to those in need, and to do no harm." Through ethics and training, the dentist should derive a deep sense of satisfaction by helping people to maintain their oral structures in a state of maximum function, comfort, and aesthetics. A well-balanced practice that actively seeks to prevent disease but is also able to care for those individuals where prevention has failed should prosper. Patients can be outstanding public relations advocates if they are convinced that their dentist and staff are truly interested in preventing disease.

If for no other reason, a dentist should consider prevention to avoid possible legal problems. A now strongly supported law for medicine, but to a lesser extent for dentistry requires that prior to treatment, all options be explained to secure patient consent. This discussion should include a comparison of health benefits and hazards, as well as the economic and oral health benefits of prevention. Both long-term patients and the court system are taking a more unsympathetic attitude toward practitioners who have permitted a disease to progress over many years without having taken some primary preventive actions to have slowed, or halted its progress. Patients no longer tolerate supervised professional neglect.

WHAT IS PRIMARY PREVENTION?

When discussing primary prevention, it is first necessary to define a few key words. *Health* is what we want to preserve, and is defined as "a state of complete *physical, mental,* and *social* well-being, and not merely the absence of disease or infirmity." For instance, some individuals may actually be in excellent health, but believe for some reason logical to them, that they have oral cancer. Such individuals do not have an appropriate mental well-being and will continue to worry until they are somehow convinced otherwise that they are indeed healthy. Another person may be functionally healthy, although facially disfigured, and as such be socially shunned throughout life. Thus, health can at times be what the patient thinks and *not* the condition of the body. Even the phrase *preventive dentistry* has different meaning to different people. As a result, preventive dentistry has been broken down into three different levels.

1. *Primary prevention* employs techniques and agents to forestall the *onset* of disease, to *reverse* the progress of the disease, or to *arrest* the disease process before treatment becomes necessary.
2. *Secondary prevention* employs routine treatment methods to *terminate* a disease process and to *restore tissues* to as near normal as possible.
3. *Tertiary prevention* employs measures necessary to *replace* lost tissues and to *rehabilitate* patients to the point that physical capabilities and/or mental attitudes are as near normal as possible after the failure of secondary prevention (Fig. 1–1).

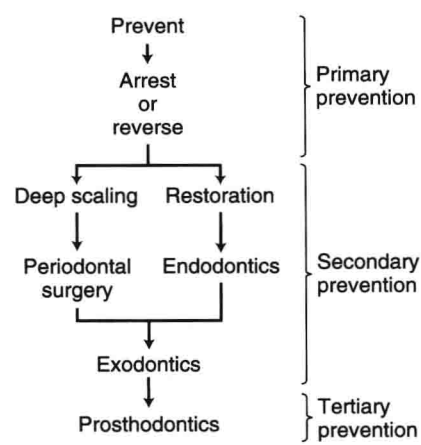

Figure 1–1. From natural teeth to denture teeth in three not-so-easy stages.

Question 1

Which of the following statements, if any, are correct?

A. The absence of a disease or infirmity is a good sign of physical health, but not of mental and social well-being.

B. A professional football player who looks well, has no physical infirmities, but continually worries about his $10 million contract, can be considered in excellent health.

C. An amalgam restoration that is placed in a carious occlusal pit of a molar is an excellent example of **tertiary** prevention.

D. The avoidance of an etiologic factor for a specific disease is an example of **primary** prevention.

E. Preventive dentistry, in its broadest sense, embodies primary, secondary and tertiary prevention.

In going from primary to tertiary prevention, the cost of health care increases exponentially and patient satisfaction decreases proportionately. An excellent example of these levels of care is the treatment of an individual with poliomyelitis. The cost of the polio *vaccine* is only a *few dollars* and the use of this vaccine to prevent the onset of the disease is inexpensive and effective. But, for someone not adequately immunized, the cost of treatment for poliomyelitis and subsequent rehabilitation approximates $50,000 or more for the first 7 weeks of hospitalization and outpatient care.[5] Yet, the individual receiving the $50,000 worth of tertiary preventive treatment is certainly not as happy as the one who received only a few dollars' worth of primary preventive care. Another appropriate example is the fluoridation of drinking water. This costs approximately $0.50 per year per individual, yet it reduces the incidence of dental caries in the community by 20 to 40 percent. If this primary preventive measure is not instituted, the necessary restorative dentistry (secondary prevention) can cost approximately 100 times more—or about $50.00 per restoration.[3] Finally, if restorative dentistry fails, as it often does, prosthetic devices must be constructed at an even greater cost. This disparity between the lower cost of prevention and the much higher cost of treatment must be seriously considered if the United States is to develop an affordable national health program in which dentistry is represented.

This text emphasizes *primary prevention,* and specifically focuses on primary prevention as it applies to the control of dental caries and periodontal disease. On the other hand, it must be recognized that primary prevention often fails for many reasons. When such failure occurs, two actions are *essential* to contain the damage: (1) *early identification* of a lesion and (2) *immediate* treatment of the lesion, once identified.

CATEGORIES OF ORAL DISEASE

For planning purposes, dental diseases and abnormalities can be conveniently grouped into four categories: (1) *dental caries,* (2) *periodontal disease,* (3) *acquired oral conditions* other than dental caries and periodontal disease, and (4) *hereditary disorders.*

The treatment of caries and periodontal disease (and their sequelae) accounted for most of the $43.2 billion treatment bill for the estimated 40 to 50 percent of the public who regularly visited the dentist in 1996.[6] Both caries and inflammatory periodontitis are due to the presence of a pathogenic dental plaque and hence are known as the *plaque diseases.* Any major reduction in the incidence of caries and periodontal disease will release resources for the investigation

and treatment of conditions included in the third and fourth categories. The *ideal,* or *long-range planning objectives* for treating both dental caries and periodontal disease should be the development of a delivery system and methods to attain a *zero-* or *near-zero disease incidence*[c] for the target population. However, a more *realistic* and feasible, *shorter-term* goal is the attainment of a zero- or near-zero rate of *tooth loss* from these diseases. Because of the varied etiology of the third and fourth categories, that is, other acquired conditions and hereditary disorders, the planning for the control of each of these problem areas must be addressed and placed within the priorities of any overall health plan developed.

STRATEGIES TO PREVENT THE PLAQUE DISEASES

Before providing an overview of the methods used to implement primary prevention programs, it is important to point out that *both* dental caries and inflammatory periodontal disease are transmissible infectious processes. Any infectious (acquired) disease can only begin if the challenge organisms are in sufficient numbers to overwhelm the combined *body defense* and *repair* capabilities. For this reason all strategies to prevent, arrest, or reverse the plaque diseases are based on (1) reducing the number of challenging oral pathogens, (2) building up the tooth defenses and maintaining a healthy gingiva, and (3) enhancing the repair processes.

For both caries and periodontal disease, if the *incipient* lesions of caries and inflammatory periodontitis are recognized at the time of the dental examination they can often be easily reversed with primary preventive strategies. For caries, the incipient lesion is a "*white spot,*" which occurs on the surface of the enamel as a result of acid-induced *demineralization* occurring *beneath the enamel surface.* For periodontal disease, the incipient lesion is *gingivitis* (i.e, an inflammation of the gingiva), which occurs along the gingiva that is *in contact with* the plaque. Not all "white spots" go on to become caries, nor do all cases of gingivitis go on to become periodontal disease. In both cases, it should

Question 2

Which of the following statements, if any, are correct?

A. The total spectrum of **preventive dentistry** includes only the use of primary preventive techniques or agents.

B. The **broad concept** of preventive dentistry places major emphasis on primary preventive care, but also considers the need for secondary and tertiary preventive care.

C. Because dental caries and periodontal disease are infectious diseases (true), they are **acquired** conditions.

D. The **ideal,** or **long-range** objective for dentistry is a zero annual extraction rate; the more realistic, and much more encompassing **short-range objective** is the development of primary preventive measures to prevent the **onset** of **any pathology.**

E. Acquired conditions (other than caries or periodontal disease) and hereditary diseases and abnormalities account for the **great proportion** of income derived by the dental profession.

[c]Disease *incidence*—The number of new lesions or cases that occur over a given time; two examinations are required—one before the given time, and one at the end.

Disease *prevalence*—The number of lesions or cases in a population at any given time; only one examination required.

be noted that if dental plaque did not exist, or if the adverse effects of its microbial inhabitants could be negated, the decrease in the incidence of the plaque diseases would be *very* dramatic. *Based on these facts, it is understandable why plaque control is so important in any oral health program.*

To control the plaque diseases with *available* methods and techniques, strong emphasis has been directed to five general areas: (1) *mechanical and chemical plaque control,* (2) *use of fluorides* to depress *demineralization* and to enhance *remineralization,* (3) *sugar discipline,* (4) use of *pit and fissure sealants,* and (5) *education and health promotion.* A brief review of each of these primary preventive procedures will serve as a basis for the more detailed information presented in later chapters.

Plaque Control

Dental plaque is composed of salivary proteins that adhere to the teeth, plus bacteria and end-products of bacterial metabolism. Caries is a result of a pathogenic plaque which can accumulate on all five sides of the crown of a tooth and on the root surface. Gingivitis is also the result of a pathogenic plaque that accumulates along the gingival surface of the tooth and into the gingival sulcus.[d] Plaque accumulates more profusely in these specific areas because none of these locations is optimally exposed to the normal self-cleansing action of the saliva, the abrasive action of foods, or the muscular action of the cheeks and tongue. Plaque decreases in thickness as the incisal or occlusal surface is approached. Little plaque is found on the occlusal surface except in the pits and fissures. Here the amount is greatest where the fissures are deep and narrow. In the gingival sulcus between the gingiva and the tooth, little or no plaque normally occurs until gingival inflammation begins, at which time the bacterial population increases in quantity and complexity as the disease state intensifies. Plaque forms more profusely on malposed teeth or on teeth with orthodontic appliances, where access for cleaning is often difficult.

It is important to differentiate between the *supragingival* and the *subgingival* plaques. The *supra*gingival plaque can be seen above the gingival margin; the *sub*gingival plaque is found in crevices or pockets below the gingival margin, where it is not visible. The supragingival plaque harbors specific bacteria that can cause supragingival (coronal) caries. The subgingival plaque microbiota is mainly responsible for periodontal problems and root surface caries. The bacterial populations of each of these plaques differ qualitatively and quantitatively in health and disease.[7] The pathogenicity of each of the plaques can vary independently of the others. For example, it is possible to have periodontal disease with or without caries, to have neither, or to have a shifting status of caries or periodontal disease, or both.

In many cases plaque is difficult for a patient to identify. This problem is overcome, at least in the case of the supragingival plaque, by the use of disclosing agents, which are harmless dyes such as the red-staining agent, FD&C Red. The dyes may be in solution and painted on the teeth with a cotton applicator, or they may be tablets which are chewed, swished around the mouth, and then expectorated. Once disclosed, most of the supragingival plaque can be easily removed by the daily use of a toothbrush and floss (Fig. 1–2). Plaque can also be removed at appropriate intervals by the dental hygienist or a dentist as part of an oral prophylaxis. This is a procedure that has

[d]Around the tooth there is a shallow sulcus. When gingivitis is prolonged, this sulcus becomes colonized from the supragingival plaque, and if the infection is prolonged, the sulcus becomes a deeper *pocket* which indicates the onset of inflammatory periodontitis.

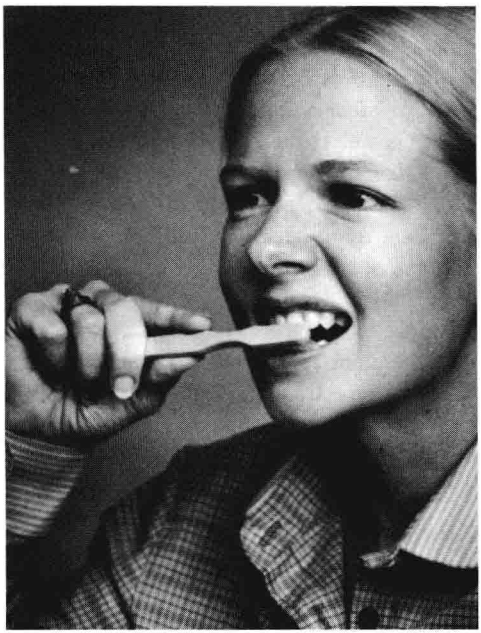

Figure 1–2. Plaque control is essential.

as its objective the mechanical removal of all *soft* and *hard* deposits, followed by a polishing of the tooth surfaces. However, because daily removal of the plaque is most effective, it is the individual—not the hygienist or the dentist—who is vital to preserving intact teeth (Fig. 1–3).

One site where neither dentist nor individual can successfully remove plaque is in the depth of pits and fissures of occlusal surfaces where the orifices are too small for the toothbrush bristle to penetrate (see Chap. 10). The flow of saliva or the muscular action of the cheeks and tongue also have little influence over the eventual development of caries in these areas. Not coincidentally, the occlusal surface is where the greatest percentage of caries lesions occur. It is for this reason that it is recommended that all occlusal surfaces with deep convoluted fissures be sealed with a pit-and-fissure sealant.

As soon as the plaque is removed from any tooth, it *immediately* begins to reform. This should not be unexpected, since by definition, dental plaque is composed of salivary residue, bacteria, and their end-products, all of which are always present in the mouth. Thus, a good plaque control program must be *continuous.* It must be a *daily commitment* over a lifetime.

Question 3

Which of the following statements, if any, are correct?

A. The five general areas that form the basis for **primary** prevention of dental diseases are (1) plaque control, (2) fluorides, (3) sealants, (4) restorations, and (5) education and patient compliance.

B. Plaque is found only on the smooth surfaces of the enamel.

C. Plaque removal requires instrumentation by a dentist or a dental hygienist.

D. Good flossing and toothbrushing techniques can completely remove the supragingival plaque from **all** tooth surfaces.

E. The daily removal of plaque by an individual is more effective than a semi-annual removal by the dental hygienist.

Not only does the daily removal of dental plaque reduce the possibility of dental caries; equally important, it also reduces the possibility of the onset of gingivitis. The metabolic end-products of bacteria that are contained in the plaque can be irritating to the adjacent gingival tissues, producing inflammation (i.e., gingivitis). If the inflammation continues, bleeding (hemorrhage) can be expected following even minimal pres-