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EFFICIENT ANTIMICROBIAL TREATMENT IN PERIODONTAL MAINTENANCE CARE

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ABSTRACT

Background. The goal of follow-up care after periodontal therapy is to preserve the function of individual teeth and the dentition, ameliorate symptoms and simplify future surgery or make it unnecessary. Effective follow-up periodontal care depends on early diagnosis and treatment, as well as patient education.

Results. The main determinants of successful periodontal maintenance therapy are dental professionals' ability to combat periodontal infections and patients' compliance with prescribed follow-up care. Mechanical and chemical antimicrobial intervention is the mainstay of preventive periodontal therapy. Chemotherapeutics alone are unlikely to be effective in the presence of subgingival calculus, underscoring the importance of subgingival mechanical débridement. Also, because toothbrushing and rinsing alone do not reach pathogens residing in periodontal pockets of increased depths, oral hygiene procedures should include subgingival treatment with home irrigators or other appropriate self-care remedies.

Clinical Implications. When considering possible preventive therapies, dental professionals must weigh the risk of patients' acquiring destructive periodontal disease against potentially adverse effects, financial costs and inconvenience of the preventive treatment. The authors discuss theoretical and practical aspects of follow-up care for patients with periodontal disease. In addition, because it can be both difficult and expensive to control periodontal disease via conventional preventive measures alone, they present a new, simple and more cost-effective antimicrobial protocol for supportive periodontal therapy.

The initial course of periodontal therapy and follow-up care are essentially based on the premise of periodontal diseases being infectious disorders. Despite enhanced efficacy of newer antimicrobial treatments, therapeutic failure can occur and reinfection of periodontal sites is always a possibility. Also, long-term response to periodontal therapy is difficult to assess, and no definitive criteria exist for curing periodontitis. This makes optimal management of periodontitis unclear and underscores the need for clinicians to frequently monitor the patient's periodontal health with close clinical and, in some cases, microbiological follow-up. However, optimal follow-up care is poorly defined, and preventive periodontal programs are often designed presumptively. There is no uniformity of opinion in regard to the optimal periodontal health maintenance procedures and frequency of preventive care appointments.

In this article, we outline current approaches to follow-up care after initial ("definitive") periodontal therapy and advance a suitable protocol for periodontal maintenance care. We assume the reader is familiar with current concepts of antimicrobial therapy in the initial course of periodontal treatment.[1,2]

CONCEPTS OF PERIODONTAL HEALTH MAINTENANCE AND DISEASE PREVENTION

Destructive periodontal disease is largely preventable, but is occasionally stubborn and tenacious, requiring complex and frequent intervention by the dental professional. Follow-up periodontal care is particularly difficult in patients with serious underlying disease. Successful treatment requires that the practitioner arrive at the proper diagnosis, have adequate knowledge

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about efficacious antimicrobial periodontal therapy, and consider the often-complex personal and economic circumstances of the patient.

Preventive periodontal therapy can be categorized as primary, secondary or tertiary. Primary prevention aims to reduce risk factors (for example, dental plaque removal, immunization against possible periodontal pathogens) before clinical presentation of disease and can be accomplished by intervention strategies aimed at both the general public and special, high-risk populations. The latter group includes people with a family history of severe periodontal disease; pregnant women; diabetic patients; patients infected with the human immunodeficiency virus; patients with neutrophil defects; and people with various behavioral risk factors, such as smoking and excessive consumption of refined carbohydrates (in dental caries–prone subjects). Patients at high risk of developing periodontitis should be monitored more closely and treated more aggressively.

The aim of secondary prevention is to intervene at early disease or precursor states (for example, treating gingivitis to prevent the development of periodontitis). Tertiary prevention seeks to limit the impact of established disease (for example, resection of deep periodontal pockets to reduce nidi for plaque accumulation and risk of future breakdown).

All types of preventive periodontal therapy are contingent on good patient compliance (that is, collaboration) and often on some behavioral changes—including alterations in oral hygiene measures, smoking status and diet—that may be difficult even for motivated patients. Compliance is the end product of many factors, including clear recommendations that are conceptually simple and convenient to follow, and proper attention to financial costs. Moreover, the more effective are the preventive measures provided by the dental practitioner, the less periodontal health maintenance has to rely on patients' own efforts.

Effective periodontal maintenance care must identify the elements of an efficacious course of professional and patient-performed preventive therapy and the frequency of maintenance care appointments.

CURRENT APPROACH TO PERIODONTAL MAINTENANCE CARE

Periodontal follow-up care varies greatly from clinician to clinician and from patient to patient. However, a typical maintenance appointment for patients with periodontal disease includes the following[3]:

- chart review and update of medical and dental history;
- extraoral clinical examination;
- mucosal examination;
- dental examination (including assessment of dental caries, restorative and prosthetic evaluation, assessment of tooth mobility and fremitus);
- periodontal examination (including probing depths, gingival recession, furcation involvement, gingivitis and bleeding on probing, gingival exudation, plaque and calculus levels and occlusal examination);
- radiographic evaluation;
- assessment of the patient's self-reported oral hygiene regimen;
- possible microbiological monitoring;
- removal of supragingival deposits;
- removal of subgingival accretions;
- behavior modification (including oral hygiene instruction and control of risk factors such as smoking cessation);
- planning future appointments.

The typical maintenance care appointment is one hour, and no more than 30 to 40 minutes usually is allocated to scaling and root planing.[3-5] The presence of deep periodontal pockets and open furcations, however, can necessitate considerably longer treatment time.[5]

The frequency of maintenance care depends on patients' susceptibility to periodontal disease, but at least four appointments per year are recommended for most patients with a history of periodontitis.[6] Some clinicians have used intervals of two weeks, two to three months, three months, three to four months, and four to six months between maintenance visits.[6] Accordingly, a periodontal patient receiving regular maintenance care is likely to spend four hours or more per year receiving dental treatment.

Complete removal of subgingival plaque can be difficult even when the clinician diligently débrides using hand instruments, as suggested by Pattison,[7] who performed a sealing experiment on extracted teeth coated with fingernail polish. Clinical studies reveal a diminished probability of removing subgingival accretions in sites with probing depths exceeding 5 millimeters.[8,9] In these situations, surgical therapy or other methods of eradicating subgingival pathogens may

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be needed to effectively control the periodontal infection.

Most studies show that patients who receive frequent professional preventive therapy are more likely to maintain their periodontal attachment levels than are patients who have more infrequent maintenance care appointments.[6] However, some patients lose teeth despite having regular maintenance care appointments[10,11] or derive little benefit from regular (as opposed to less frequent) appointments.[12] Haffajee and colleagues[13] found loss of clinical attachment in 18 (32 percent) of 57 patients with adult periodontitis who had received three or more hours of initial scaling and root planing, and then maintenance scaling and oral hygiene instruction every three months for a nine-month period. Cugini and colleagues[14] found that most of the limited clinical and microbiological improvements in their subjects occurred within the first six months after initial therapy, suggesting that the therapeutic benefits were due more to initial therapy than to maintenance therapy.

Patient compliance. Compliance with prescribed follow-up care is of major importance in the prevention of periodontal disease. However, Wilson[15] found that only 50 percent or fewer patients adhere to prescribed oral hygiene regimens. In noncompliant patients, increased reliance is placed on the dental professional to ensure effective control of periodontal pathogens.

Inappropriate prevention. Inappropriate preventive therapy can result in a number of adverse events. For example, overly aggressive scaling and root planing can remove excessive tooth structure and produce an hourglass appearance at the root-crown interface.[16] Subgingival scaling in shallow periodontal sites can traumatize the periodontal attachment and give rise to gingival recession, tooth sensitivity and, subsequently, root-surface caries.[17] Forceful horizontal toothbrushing is a common cause of gingival recession and tooth-surface abrasion.[18] High-pressure subgingival irrigation may force abscess-producing bacteria into the gingivae, even though this seems to be a low-risk event.[19] Inappropriate antimicrobial chemotherapy can lead to development of microbial resistance and hypersensitivity reactions.[20]

Patients who receive frequent professional preventive therapy are more likely to maintain their periodontal attachment levels than are patients who have more infrequent maintenance care appointments.

In addition, a relatively high proportion of patients who receive maintenance care experience disease recurrence, probably because of ineffective professionally administered antimicrobial therapy and the difficulty of adhering to prescribed oral hygiene regimens and regular maintenance care appointments. Moreover, current periodontal maintenance care is associated with relatively high financial costs, including lost productivity for the patient (time away from work) and treatment expenditures (such as the dental provider's fees and medication costs).

Need for new approaches. Therefore, new approaches are needed that are more efficacious, less likely to produce damaging effects, more readily implemented and geared toward cost-effectiveness. Effective therapies that can reduce the need for more traditional labor-intensive procedures are of particular value for impoverished patients throughout the world, who are often most seriously affected by periodontal disease. Also, as a public health concern, the notion of periodontal disease being a risk factor for cardiovascular disease, stroke and premature birth brings increased urgency to the need for controlling and preventing the disease in a cost-efficient manner.[21]

PERIODONTAL INFECTIONS

The dental practitioner's knowledge and skill in treating periodontal infections and in evaluating patient-specific factors are key elements of successful preventive therapy. Clinically important aspects of periodontal infections are discussed below and in recent publications.[1,22]

Preventive periodontal therapy can benefit significantly from consideration of bacterial specificity in periodontal disease. At a minimum, preventive therapy must target and effectively control microorganisms capable of destroying periodontal connective tissue attachment.

Pathogens. Important

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pathogens in periodontitis are *Actinobacillus actinomycetemcomitans, Porphyromonas gingivalis* and *Bacteroides forsythus.*[22] Organisms of probable periodontopathic significance include *Prevotella intermedia, Campylobacter rectus, Peptostreptococcus micros, Dialister pneumosintes, Fusobacterium* species, *Eubacterium* species, β-hemolytic streptococci, *Treponema* species and, perhaps, yeasts, staphylococci, enterococci, pseudomonas and various enteric rods.[22] Viridans streptococci serve a beneficial role in the periodontal microbiota by inhibiting growth of periodontal pathogens.[22]

Transmission of pathogens. Most periodontal pathogens are transmitted via saliva among family members.[23] A recent study found evidence of transmission of *A. actinomycetemcomitans* in 36 percent of married couples and evidence of transmission of *P. gingivalis* in 20 percent of married couples.[24] These authors also found parent-to-child transmission of *A. actinomycetemcomitans* at a rate of 32 percent.[24] The intrafamilial spread of *A. actinomycetemcomitans* and *P. gingivalis* provides a rationale for treating an entire family to prevent reinfection with periodontal pathogens. However, long-term studies are warranted to determine the value of treating entire family units.

Periodontal pathogens are located in dental plaque as well as on the dorsum of the tongue, the buccal mucosa and other oral sites.[23] To prevent reinfection of treated periodontal sites, therapy must target pathogens throughout the entire oropharyngeal cavity, not only those in individual periodontitis sites.

Biofilm. Dental plaque is a type of biofilm, defined as a sessile community of microorganisms organized within an exopolymer on a solid surface. Biofilm microorganisms may show much greater resistance to antibiotics, antiseptics and components of host defenses than their free-living counterparts. Limited diffusion within biofilms and unique biofilm phenotypes of the bacterial species reduce the effectiveness of antimicrobial agents. To overcome the protective effect of biofilms, clinicians must mechanically (by scaling and root planing) or chemically (by irrigation with dilute sodium hypochlorite, or NaClO—common household bleach) disrupt subgingival plaque at the time antibiotic therapy begins.

Microbial invasion of gingival tissue constitutes another complicating factor in antimicrobial periodontal therapy. Subgingivally applied tetracycline does not penetrate into subepithelial connective tissue.[25] *A. actinomycetemcomitans* is a tissue-invading organism that cannot always be removed via mechanical débridement or use of topical antibiotics or povidone-iodine, but it can be eradicated by a regimen of properly selected systemic antibiotics.[26]

Periodontal pathogens located in furcations too narrow to be mechanically débrided also may be difficult to reach with topical antimicrobial agents. Similarly, topical antimicrobials might not reach pathogens at the base of deep periodontal pockets. In contrast, systemic antibiotics that enter the subgingival area via gingival crevicular fluid have a greater potential of controlling pathogens on difficult-to-reach tooth surfaces.

Periodontal treatment that relies mainly on short-course intervention by dental professionals must ensure adequate suppression of subgingival pathogens between maintenance care appointments. Fortunately, treatment-induced changes in the subgingival microbiota can last three to six months or even longer.[27]

In mild-to-moderate forms of periodontitis, carefully performed supragingival plaque control may reduce the quantity of subgingival pathogens.[28] However, supragingival plaque control does not produce marked changes in the quantity and composition of subgingival microbiota in patients with advanced periodontitis who have multiple infrabony defects.[29]

Microbiological testing. Because periodontitis lesions often contain a mixture of pathogenic microorganisms with varying antimicrobial susceptibility, high-risk patients may benefit from microbiological testing. By obtaining a microbial diagnosis, the dental professional can initiate pathogen-specific antimicrobial therapy and avoid prescribing ineffective and potentially harmful drugs. Several reviews discuss the benefits and methods of periodontal microbiological testing.[30,31]

In summary, combating periodontal infections is best accomplished by combined mechanical and chemotherapeutic efforts of the dental professional and the patient.

THE DENTAL PROFESSIONAL'S ROLE IN PREVENTIVE PERIODONTAL THERAPY

Proper approaches to preventive periodontal therapy are

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similar to those used for other types of infectious diseases. As discussed above, the dental professional uses mechanical and chemical therapy as well as behavioral modification techniques to improve oral hygiene patterns (Figure 1).[32]

Regardless of the approaches used, preventive periodontal therapy must be goal-oriented. This usually involves clearly defining the endpoint of the antimicrobial therapy, obtaining active cooperation from the patient, establishing reasonable patient goals, modifying preventive methods if failure occurs and setting a time frame for future maintenance care appointments.

Even though the best preventive therapeutic regimen for each patient is difficult to define, there is little doubt that treatment directed at suppression of periodontal pathogens is at the crux of preventive periodontics. At maintenance care appointments, dental professionals not only should target pathogens residing in subgingival and supragingival sites, but also should treat periodontopathic microorganisms on the tongue and other oral sites. It may be prudent to distinguish between patients with a history of destructive periodontal disease and those with little or no history of periodontal breakdown.

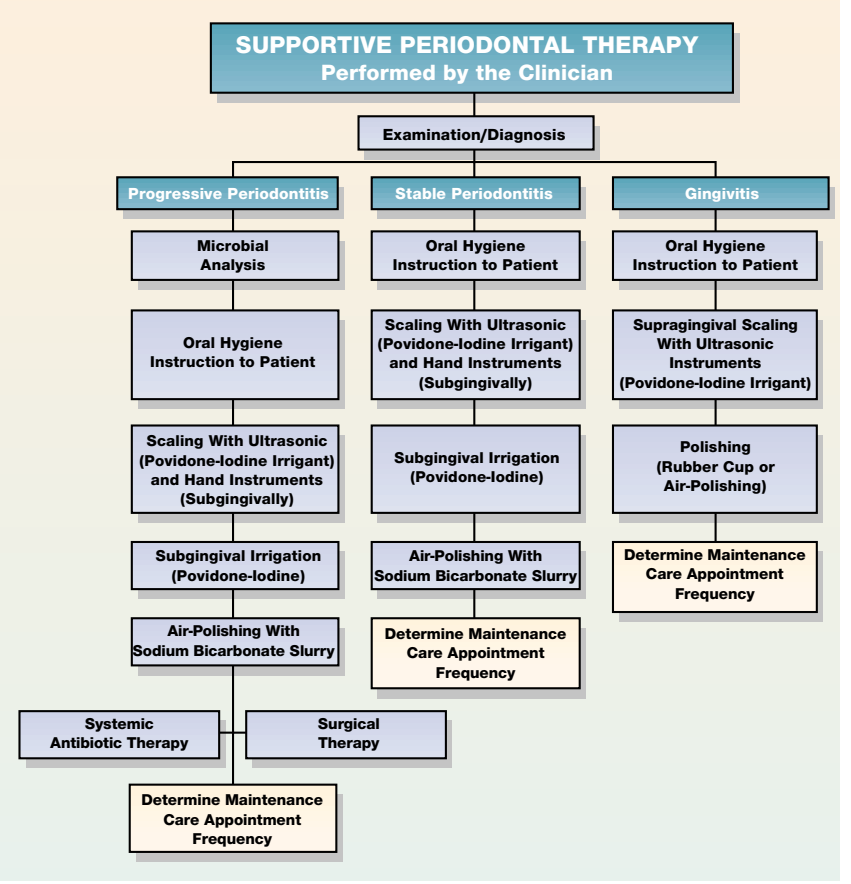

Figure 1. Supportive periodontal therapy performed by the dental professional.

Débridement. Periodontal maintenance therapy by the dental professional includes mechanical débridement and administration of antiseptic agents. Mechanical débridement might be performed only on surfaces with hard deposits since instrumentation, particularly in probing depths of 3 millimeters or less, can cause loss of tooth substance or periodontal attachment.[17] In patients who exhibit supragingival calculus formation, ultrasonic débridement is recommended, because it is faster than débridement with hand instruments and may use as an irrigant 10 percent povidone-iodine antiseptic (such as Betadine, Moore Medical Corp., which contains approximately 10 percent povidone-iodine and 1 percent free iodine) diluted with nine parts water.[26]

However, patients exhibiting tooth sensitivity may object to the use of ultrasonic scalers. In pockets with subgingival calculus, ultrasonic débridement may constitute the first approach to treatment, but because of difficulty in observing subgingival hard deposits and the lack of tactile sensation by ultrasonic scalers, hand instruments are often used for final root preparation. Nosal and colleagues[33] conducted a study of subgingival débridement and found that an irrigant delivered through ultrasonic scaling tips demonstrated complete pocket penetration in 86 percent of sites ranging from 3 to 9 mm in depth. Rosling and colleagues[34] demonstrated the benefits of using povidone-iodine in conjunction with ultrasonic scaling of periodontitis lesions. It is important to note that cleaning dental implants is just as necessary as cleaning natural teeth, but it

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should be performed with a strong polymer- or plastic-tipped hand or ultrasonic scaler instead of metal instruments to protect their surfaces from damage.

Subgingival irrigation. Because routine maintenance scaling cannot completely remove subgingival pathogenic bacteria,[14] mechanical débridement may be augmented by subgingival application of povidone-iodine (full strength or equal parts of povidone-iodine and water to facilitate delivery) via a syringe with a smooth-tipped cannula or another appropriate delivery device. A blunt-tipped irrigating cannula that is connected to a hand-held syringe or an oral irrigator and advanced at least 3 mm below the gingival margin can attain virtually complete pocket penetration.[35,36] Since subgingival calculus impedes the delivery of irrigants,[37] scaling and root planing should precede, rather than follow, subgingival irrigation. Povidone-iodine solution should be retained in subgingival sites for at least five minutes by repeated application or by means of a retraction cord.[26] Subgingival irrigation with undiluted povidone-iodine may reduce the total number of cultivable bacteria in untreated periodontitis lesions by 98 percent.[38]

Air-polishing. Air-polishing that incorporates a slurry made up of air, water and sodium bicarbonate in a commercial device (Prophy-Jet, Dentsply Preventive Care; EMS Air-Flow SII, Nyon, Switzerland) can help disrupt the subgingival microbiota. In untreated periodontitis lesions with probing depths of 5 to 7 mm, supragingival air-polishing directed at a 90-degree angle to each tooth surface for 10 seconds has been shown to significantly decrease the mean proportions of subgingival cultivable pathogenic bacteria (from 26 percent to 5 percent) and motile morphotypes (from 13 percent to 2 percent) to the total bacterial count.[39] To limit the introduction of live bacteria into gingival tissue, the clinician can perform subgingival povidone-iodine irrigation before air-polishing.

Mouthrinsing. Chlorhexidine rinsing (10 to 15 milliliters of 0.12 to 0.2 percent solution for 30 seconds twice daily for eight days) is recommended by manufacturers—as well as by us—to reduce supragingival plaque and combat periodontal pathogens in the entire oropharyngeal cavity. However, the propensity of chlorhexidine to stain teeth and tooth-colored restorations may limit its use in some patients.

Systemic antibiotic therapy, periodontal surgery or a combination of both are indicated for patients who experience recurrent destructive periodontal disease. The criteria for selecting adequate antibiotic therapy or appropriate surgical modalities are outlined elsewhere.[31]

Maintenance care appointments. The frequency of maintenance care appointments varies from patient to patient and should reflect patients' periodontal needs and possible financial constraints. Periodontal tissue status and dental plaque levels are important determinants of appointment frequency. We describe below a number of practical methods of evaluating periodontal disease status.

Periodontal probing. The progression or stability of periodontal conditions is commonly assessed via sequential periodontal probing using a manual probe with constant force. Measurement of changes in probing periodontal attachment levels (the distance from the cementoenamel junction to the base of the periodontal pocket) frequently is used in research to provide a more reliable assessment of disease progression than is measurement of periodontal pocket depth, but it is more time-consuming and may be difficult to execute in a dental office setting when the cementoenamel junction or other reference point is not readily detectable. However, Greenstein's[40] observation that most periodontal sites with pocket depths of 2 to 3 mm are clinically stable may be of diagnostic value.

Bleeding on probing. Continuous absence of bleeding on probing is a useful indicator of periodontal health. Lang and colleagues[41] found that periodontal pockets exhibiting bleeding at four consecutive maintenance care visits had a 30 percent risk of losing attachment, whereas pockets exhibiting bleeding at only one of four consecutive visits had as little as a 3 percent risk of experiencing breakdown. Wilson and Kornman[42] determined the need for appointments on a patient-by-patient basis, using the criterion of bleeding on probing, and suggested extending the interval between appointments by one month for patients with no bleeding sites and decreasing the interval by one month for patients with 16 percent or more bleeding sites. It is important to keep in mind that using bleeding on probing as an indicator of

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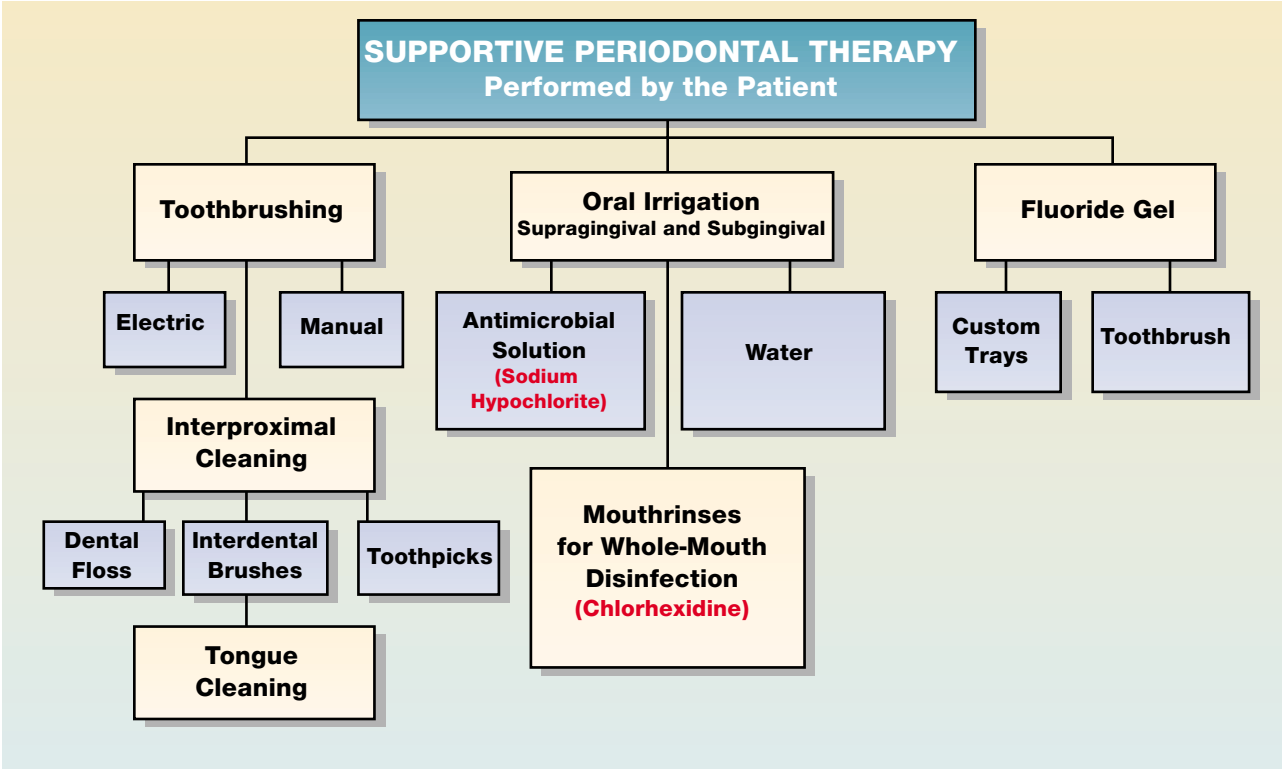

Figure 2. Supportive periodontal therapy performed by the patient.

periodontal disease activity assumes standardization of probing method and pressure.

Radiographically evident crestal lamina dura. The presence of radiographically evident crestal lamina dura is a valuable indicator of periodontal stability. Rams and colleagues[43] found that sites with radiographically evident crestal lamina dura did not undergo breakdown for at least two years. However, the absence of lamina dura is not a specific indicator of progressive periodontitis, except perhaps for periodontal lesions exhibiting deep angular defects.[44] The introduction of increasingly sensitive digital and subtraction radiography in dental office settings will further increase the diagnostic value of periodontal radiographs.[45]

Microbiological examination. A microbiological examination of subgingival plaque can indicate risk of periodontal breakdown in high-risk patients receiving supportive periodontal treatment.[46] The absence of major periodontal pathogens is a better predictor of no further loss of periodontal attachment than the presence of these organisms is of disease progression.[46] Rams and colleagues,[47] however, found increased risk of periodontitis recurring in patients who exhibited one or more of five species of bacterial pathogens and high numbers of pockets with probing depths of more than 5 mm. As discussed earlier, microbiological examination also is helpful in selecting the appropriate antimicrobial therapy.

PATIENTS' ROLE IN PREVENTIVE PERIODONTAL THERAPY

The least expensive way to manage periodontal disease is through self-care; however, the effectiveness of patients' preventive efforts is questionable. Self-care can involve various mechanical and antimicrobial approaches and should be customized for each patient, depending on periodontal conditions and the patient's ability and willingness to comply. To improve the effectiveness of self-care measures, dental professionals must communicate effectively with patients and reinforce the need for preventive periodontal therapy (Figure 2).

Motivation. Patient motivation is often difficult to elicit and should be addressed at the initial appointment. Simply asking patients to brush, floss or irrigate their teeth without a hands-on demonstration is not effective. It is important for dental professionals to explain the role of bacterial plaque as

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the primary cause of periodontal disease to help patients understand the importance of daily self-care. Areas of obvious inflammation should be pointed out so that patients recognize the presence of an adverse condition in their mouths. This should be followed by a demonstration of plaque removal from the patient's teeth, in which the clinician should use a disclosing solution to aid in plaque visualization. Patients then should be allowed to demonstrate that they are able to perform the prescribed procedures; they then should be asked to follow a plaque removal regimen once or twice each day.[48]

If reasonably effective plaque control is achieved on a regular basis, patients will notice some tangible improvements, such as decreased gingival bleeding, decreased soreness and cleaner-feeling teeth. By pointing out improvement in previously inflamed areas, the clinician can explain the positive changes achieved by the patient's daily cleaning and motivate him or her to continue with the oral hygiene regimen. Positive reinforcement at each subsequent appointment will help ensure that improvements in self-care continue.[49]

Antiplaque devices. Traditional oral hygiene instruction has emphasized the use of a soft manual toothbrush with the Bass or roll technique; however, an electric toothbrush may be more effective and cause less risk of trauma to gingival tissues.[50-52] Daily tongue cleaning, via brushing or scraping, can help reduce potential pathogenic organisms residing on the dorsum of the tongue and subsequently in saliva,[53,54] but it may not reduce the quantity of plaque formed on the teeth.[55]

In interproximal areas, routine brushing is not adequate, but interdental brushes (manual or electric) with soft bristles that bend and conform to surface irregularities may be useful.[52,56,57] Flossing or use of toothpicks can disrupt interproximal plaque formation and, if performed daily, may control interproximal gingival inflammation and prevent the onset of progressive periodontal disease.[58,59] However, dental flossing may not be effective in patients exhibiting exposed root-surface concavities, grooves or furcations. Also, most patients are unable or unwilling to comply with the need for daily flossing; various surveys indicate that less than 10 percent of patients use dental floss on a daily basis and more than 50 percent never use it.[60,61] Numerous devices are available to facilitate manipulation of dental floss,[62] which may improve compliance in some patients.[63,64] For all antiplaque measures, it is important to remember that overzealous and improper use of the toothbrush or dental floss can damage the teeth and the periodontium.[65,66]

Irrigating with an antimicrobial agent instead of plain water may increase the effectiveness of home irrigating devices.

Patients with increased pocket depths. In patients with increased pocket depths that harbor numerous periodontal pathogens, special efforts must be made to control the subgingival microbiota. Brushing, rinsing, flossing and interdental brushing do not reach periodontal pathogens at the bottom of deep periodontal pockets; small cotton swab tips may be more effective subgingivally, although patients may be hesitant to use them.[67] Toothbrushes penetrate only 0.9 mm[68] and oral rinses only 0.2 mm[36] into subgingival areas. On the other hand, oral irrigation devices designed for home use may reach as much as 50 percent of the pocket depth.[69]

Irrigation. Cobb and colleagues[70] reported that, in clinical and microbiological studies, pulsed oral irrigation at high pressure disrupted subgingival plaque to at least 6 mm into periodontal pockets without inducing soft-tissue injury or forced penetration of microorganisms into gingival tissue. A soft cone-shaped rubber tip (Pik Pocket, Teledyne Water Pik) attached to an irrigator and placed 1 mm apical to the gingival margin can deliver irrigants to a depth of 90 percent of the depth of periodontal pockets that are 6 mm or less, and to a depth of 64 percent of the depth of pockets that are 7 mm or more.[71] Subgingival irrigation can significantly decrease the number of periodontal *P. intermedia* [72] and other bacteria[70] compared with brushing.

Irrigating with an antimicrobial agent instead of plain water may increase the effectiveness of home irrigating devices. A wide variety of solutions have been advocated for home irrigation, including chlorhexidine, acetylsalicylic acid, hydrogen peroxide, NaClO, metronidazole and

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PERIODONTAL MAINTENANCE THERAPY: A TREATMENT PROGRESSION.

1. EXAMINATION

Patients with a history of destructive periodontal disease should be screened carefully for signs of ongoing periodontal destruction. Periodontal examination should include full-mouth probing, measuring pocket depth and attachment level; assessment of bleeding on probing, suppuration, gingival edema, gingival redness and dental plaque, dental calculus and other tooth deposits; and periodic radiographic examination. Microbiological analysis is indicated when signs of disease activity are noted.

2. REMOVAL OF CALCULUS

Supragingival calculus should be removed by ultrasonic scaling or hand instrumentation, and subgingival calculus by a combination of ultrasonic scaling and hand instrumentation. A recommended irrigant in the ultrasonic scaler is 10 percent povidone-iodine diluted 1:9 with water; a more concentrated solution may be used if the patient accepts it. Iodophors should not be administered to patients who report sensitivity to iodine or are susceptible to hypothyroidism, nor to pregnant patients or nursing mothers because the fetus or infant could develop transient hypothyroidism.

3. USE OF POVIDONE-IODINE

Periodontal microorganisms are killed with full-strength povidone-iodine or equal parts povidone-iodine and water retained in subgingival sites for at least five minutes. A syringe with a smooth-tipped cannula may be used for subgingival iodine application.

4. DÉBRIDEMENT

Subgingival débridement is completed using an air-polishing device directed at a 90-degree angle to each tooth surface for five seconds. This procedure reduces levels of subgingival pathogens and causes little or no harm to the tooth surface.

5. PRESCRIPTION OF A SELF-CARE REGIMEN

Self-care should be discussed with the patient and a suitable regimen prescribed (Figure 2). Patients with a history of periodontal disease can be advised to use an electric toothbrush, subgingival irrigation, dental floss, interdental brushes (or perhaps toothpicks) and tongue-cleaning devices. Subgingival irrigation can be performed with 0.05 percent to 0.1 percent sodium hypochlorite; a fresh solution should be prepared for each use, since the available chlorine is not stable for more than a few hours. The patient can prepare an effective and inexpensive hypochlorite solution by combining a teaspoon of 5.25 percent sodium hypochlorite (household bleach) with 200 to 300 milliliters—about two large drinking glasses—of water. Frequency of hypochlorite irrigation can be tailored to patients' rates of plaque formation and taste sensation and may be alternated with plain water irrigation. Patients who are at high risk of developing endocarditis or have recently received prosthetic orthopedic implants should refrain from performing self-administered supragingival and subgingival irrigation because of the risk of developing bacteremia.

6. USE OF CHLORHEXIDINE RINSES

Rinsing with 10 to 15 mL of 0.12 to 0.2 percent chlorhexidine solution twice daily for one to two weeks in conjunction with each maintenance care appointment can help reduce pathogens in the entire oropharyngeal cavity. The propensity of chlorhexidine to stain teeth and tooth-colored restorations may limit its use in some patients.

7. INDIVIDUALIZATION OF TREATMENT

- **Patients with progressive periodontitis.** Patients with ongoing periodontal destruction may benefit from microbial sampling and subsequent use of an appropriate systemic antibiotic. Thorough mechanical débridement must be instituted in these patients, sometimes requiring a surgical approach. Recall intervals should be no greater than three months, and even more frequent follow-up appointments may be indicated. Additional antimicrobial remedies (outlined in the text) also should be applied to patients who exhibit refractory periodontitis.

- **Patients with stable periodontitis.** Patients whose periodontitis appears stable, with sites that show no hard supragingival or subgingival deposits, require little or no mechanical débridement. In these patients, antimicrobial treatment focuses on the mechanical removal of supragingival plaque and antiseptic suppression of subgingival microorganisms. Subgingival application of povidone-iodine followed by air-polishing treatment is the principal approach to antimicrobial therapy with these patients. Patients whose periodontal condition is stable generally are scheduled for maintenance care appointments at four-month intervals; intervals can be adjusted depending on the patient's periodontal status and effectiveness of oral hygiene.

8. PREVENTION OF ROOT CARIES

Successful periodontal treatment often results in gingival recession and caries-prone exposed root surfaces. Fluoride treatment—application of 0.4 percent stannous fluoride gel via a tray or toothbrush—of exposed root surfaces is an important caries-preventive measure, especially in elderly patients, who often have reduced salivary flow and a diet high in sucrose.

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magnetized water.[73-82] Chlorhexidine generally is not recommended for home irrigation because of its tendency to stain tooth surfaces and its binding to and inactivation by organic matter in the gingival crevicular fluid. However, 0.12 to 0.2 percent chlorhexidine mouthrinse used twice daily for one to two weeks is a valuable aid in whole-mouth disinfection.

NaCIO solution. Lobene and colleagues[77] found that irrigation with diluted (0.5 percent) NaCIO solution caused significantly greater and longer-lasting reduction in plaque and gingivitis than did irrigation with water. However, some patients may find the taste of a 0.05 to 0.1 percent NaCIO solution more agreeable.

SUGGESTED USE OF ANTIMICROBIALS IN SUPPORTIVE PERIODONTAL THERAPY

The key issues for dental professionals conducting preventive periodontal care are to identify the optimal type of therapy at maintenance care appointments, the optimal frequency of maintenance care appointments and the most appropriate self-care program. Virulence of periodontal pathogens and systemic and local host resistance determine the severity of periodontal disease. A certain dental plaque and pathogen level in a 45-year-old man with no environmental or systemic risk factors tends to be associated with much less periodontal destruction than the same pathogen level in a 45-year-old male smoker with poorly controlled diabetes. Thus, the clinician may have to decide—on a case-by-case basis—what constitutes excessive levels of pathogenic plaque bacteria and then balance the potential benefits, risks and costs of treatment. Whatever preventive strategy is chosen, its main purpose should be clear: to control levels of periodontal pathogenic bacteria by treating them with safe and effective therapies.

Some clinicians prefer to enroll all adults in a comprehensive periodontal maintenance program, believing that all patients are eventually at risk of developing periodontitis. The clinician who chooses this strategy should recognize that some patients will experience periodontal breakdown despite maintenance therapy, while many others will exhibit no significant loss of periodontal attachment around most teeth throughout a lifetime. The clinician then will have to decide the appropriateness of instituting extensive maintenance therapy of uncertain benefits with healthy or minimally diseased patients. However, clinicians may reasonably choose to apply different maintenance regimens to patients with a history of destructive periodontal disease and to patients with little or no evidence of periodontitis (Box, "Periodontal Maintenance Therapy: A Treatment Progression").

Patients with gingivitis. The optimal preventive strategy for adults who have experienced gingivitis but little or no destructive periodontal disease is not clear. Periodic screening examinations will facilitate early detection and prompt intervention should attachment loss begin. A six-month interval between maintenance care appointments for patients without a history of periodontitis generally is adequate. At maintenance care visits, clinicians should remove stains and deposits on the teeth; record probing depths, attachment levels and bleeding on probing; and discuss plaque control with patients.

Even in patients who do not appear to be predisposed to destructive periodontal disease, effective daily plaque control is desirable. For these patients, daily brushing and flossing are generally sufficient; however, as discussed above, compliance with daily flossing is often low. Some patients may be willing to use other interdental cleaning devices, such as toothpicks or oral irrigating devices. Patients using oral irrigation should be encouraged to augment water irrigation with periodic use of a 0.05 to 0.1 percent solution of NaCIO or other antimicrobial agents. If signs of trauma from overzealous and improper use of the toothbrush or dental floss are detected, dental professionals must make patients aware of the situation and provide training in more appropriate oral hygiene measures.

Through daily plaque control procedures and periodic professional monitoring, patients who have not yet experienced destructive periodontal disease can control gingivitis, avoid future periodontal breakdown and enjoy a comfortable and esthetic periodontium.

CONCLUSION

We have summarized clinical and microbiological data that suggest proven—or at least rational—methods of preventing the onset or recurrence of destructive periodontal disease. Where there is uncertainty, we have recommended the simplest of procedures. While it is not

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our intention to suggest that the preventive approaches outlined above constitute the only solutions, this article should help promote the best use of available resources and, ultimately, assist dental professionals in their attempts to minimize the level of periodontal disease among their patients.

Traditionally, primary, secondary and tertiary prevention of periodontal disease has been aimed at controlling supragingival dental plaque. Current concepts have been broadened to consider more sophisticated means of managing periodontal infections and include treatment of periodontal pathogens residing in the entire oropharyngeal cavity. Until recently, preventive periodontal strategies consisted mainly of mechanical débridement at maintenance care appointments and patients' daily toothbrushing and flossing. The current emphasis in periodontics is on mechanical débridement as well as on treatment with antimicrobial agents. General application of the periodontal treatment modalities described here prevented additional attachment loss for five years in 35 patients with advanced periodontitis.[1] Long-term clinical and microbiological studies in different patient populations are needed to compare the efficacy and cost-effectiveness of this approach with other approaches to periodontal maintenance therapy.

The next decade could bring about important changes in the treatment of periodontal diseases. Innovative antimicrobial agents and delivery systems as well as radical new approaches based on vaccination against herpesviruses or pathogenic bacteria may significantly reduce the incidence of periodontitis and dramatically simplify the antimicrobial efforts in preventive periodontics. More effective, less time-consuming and more readily acceptable treatment modalities will improve the periodontal health of individual patients and the general public. ▪

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