

# CHAPTER 8. NON-SURGICAL THERAPY

## Section 1. Studies

Periodontal therapy can be broadly classified as surgical and non-surgical therapy. Non-surgical therapy includes plaque control, supra- and subgingival scaling, root planing, and the adjunctive use of chemical agents. The purpose of this section is to review longitudinal studies of non-surgical therapy.

The first comparison of surgical and non-surgical therapy was reported by Pihlstrom and coworkers (Minnesota studies). Subsequently there were reports by Ramfjord and coworkers (Michigan studies), Lindhe and coworkers (Gothenburg studies), Isidor and coworkers (Aarhus studies), Becker and coworkers (Tucson-Michigan-Houston studies), and Kaldahl and coworkers (Nebraska studies). Egelberg and coworkers (Loma Linda studies) examined the effect of non-surgical therapy on attachment levels. For all but the Loma Linda studies, a control group or control side was employed.

Some studies used single-rooted teeth only while others included multi-rooted teeth. All studies were done in a university setting except for the Tucson-Michigan-Houston studies which were conducted in a private practice setting.

An inconsistency in the various reports exists regarding the effect of personal oral hygiene. While it is clear to anyone involved in periodontal therapy that the better the personal plaque control, the better the result, it is not clear that perfect plaque control must exist to have a generally successful result (Ramfjord et al., 1982). The Minnesota, Michigan, and Aarhus studies reported that patients with imperfect plaque control fared as well, in terms of attachment level results, as patients with high plaque control scores. The Gothenburg studies reported that plaque-free sites did not lose attachment while plaque-associated sites tended to lose attachment. The Aarhus studies reported that the Gothenburg studies performed only supragingival tooth-cleaning at maintenance visits while the Minnesota, Michigan, and Aarhus groups performed subgingival cleaning during maintenance. The subgingival cleaning apparently helps disrupt the subgingival ecosystem and reduce the pathogenicity of the flora, thereby minimizing attachment loss even in the face of imperfect patient performed oral hygiene efforts. This means that subgingival instrumentation is absolutely essential at maintenance visits.

### LONGITUDINAL STUDIES

**Minnesota Studies.** Pihlstrom et al. (1981), in a 4-year study utilizing multi-rooted teeth, compared scaling and root planing (S/RP) to modified Widman surgery. Seventeen (17) patients received thorough S/RP (RP group) as

well as OHI. A modified Widman flap (RP+Sx) was then performed on one half of each subject's dentition. Patients were recalled 3 to 4 times a year for 4 years. The data were separated into 3 groups by initial pocket depth; 1 to 3 mm, 4 to 6 mm, and  $\geq 7$  mm. Both methods resulted in increased probing depth and loss of attachment in the 1 to 3 mm group. In the 4 to 6 mm group both procedures resulted in reduction in probing depth and maintenance of attachment levels with the RP resulting in slightly more gain in attachment. The  $\geq 7$  mm group showed the greatest reduction in probing depth and gain in attachment with better results in the RP+Sx procedures. The results indicate that both procedures were effective in treating moderate to advanced periodontitis. The additional flap procedure tended to result in greater probing reduction and attachment gain for deeper pockets. The present study also indicated that it may be possible to arrest the progress of periodontal disease even in the presence of relatively poor plaque control by the patient.

Pihlstrom et al. (1983) in a second report analyzed the 6.5 year results of the previous study. This report concludes that scaling and root planing alone or in combination with modified Widman flap surgery resulted in sustained decreases in gingivitis, plaque, and calculus and neither procedure appears to be superior with respect to these parameters. Seventeen (17) patients diagnosed with moderate-advanced periodontitis were utilized in a split-mouth design study to compare the effects of scaling and root planing alone and combined with modified Widman flap surgery. Data were collected at baseline, 6 months following active therapy and every year up to 4 years, then at 5 1/2 and 6 1/2 years. Probing depth did not change for 1 to 3 mm pockets treated by either scaling and root planing alone or in combination with modified Widman flap surgery. For pockets 4 to 6 mm, both treatment procedures resulted in equally effective sustained pocket reduction. Deep pockets ( $\geq 7$  mm) were initially reduced more by the flap procedure. After 2 years, no consistent difference between treatment methods was found in degree of pocket reduction. For pockets initially 4 to 6 mm in depth, attachment level was maintained by both procedures. Pockets  $\geq 7$  mm in depth treated by either procedure resulted in a sustained gain in attachment.

Pihlstrom et al. (1984) in a third report examined the response of molar and non-molar teeth to scaling and root planing alone or S/RP plus a flap procedure. At 6 1/2 years, non-molar teeth had an average of about 1.0 mm less probing depth than molar teeth irrespective of type of procedure performed. There was greater probing depth and more apical attachment level on molar than on non-molar teeth treated by either method for 4 to 6 mm pockets. In  $\geq 7$  mm pockets, the flap resulted in less pocket depth on non-mo-

lars than molars, but no difference in the attachment level for either method. Nineteen (19) of the 453 teeth included in the study were extracted throughout the study; 11 of these were extracted after therapy; 5 maxillary second molars, 2 maxillary first molars, 2 mandibular second molars, 1 deciduous canine, and 1 mandibular lateral incisor.

**Michigan Studies.** Hill et al. (1981) published a 2-year study of scaling and root planing compared to modified Widman surgery. This 90-patient study included multi-rooted teeth. Following a hygienic phase which included S/RP and OHI, each quadrant was treated by 1 of 4 treatments (pocket elimination, modified Widman flap (MWF), subgingival curettage, and scaling and root planing). Measurements which included pocket depth and attachment levels were taken at the initial exam, after the hygienic phase and 1 and 2 years after treatment. In the 1 to 3 mm crevices there was a slight loss of attachment after all types of treatments. In the 4 to 6 mm pockets there was a significant reduction in probing depth after all modalities with the greatest reductions after pocket elimination and MWF, and a loss of attachment for pocket elimination and a gain for curettage and scaling. In the  $\geq 7$  mm pockets there was a significant reduction after all modalities with the greatest reduction after pocket elimination, and no significant differences in attachment results among the 4 methods. None of the surgical modalities had any better effect than scaling and root planing alone in maintenance of periodontal support which was not directly related to reduction in pocket depth.

The following 2 studies were part of the Michigan surgery studies but point out the effects of patient-performed oral hygiene measures. Ramfjord et al. (1982) studied 78 patients treated with occlusal adjustment, followed by surgical therapy, and recall prophylaxis every 3 months for 8 years. They were grouped into 3 classes: 1 to 3 mm, 4 to 6 mm, and 7 to 12 mm. Plaque was scored according to the periodontal disease index (PDI). The scores were used to test the hypothesis of equal effect of plaque scores above and below the median for the 3 severity groups of the initial disease based on probing depth. The 25% of patients with the highest plaque scores in 1 group and the 25% with the lowest scores in another group were also compared. These scores were then related to variations in probing depth and attachment levels. The results showed no more return of probing depth with poorer than average oral hygiene than with better than average. A comparison of the 25% of patients having the lowest plaque scores with the 25% having the highest score showed no significant differences in pocket depth responses over the 8 years. After 1 year, there was no indication that poorer oral hygiene leads to a greater loss of attachment than better oral hygiene. Similar results were seen in the 4 to 6 and the  $\geq 7$  mm group after 4 years of study.

Morrison et al. (1982) in another examination of data from the previously mentioned 8-year longitudinal study analyzed the effect of gingivitis scores on probing depth

and attachment levels. For pockets 1 to 3 mm and 4 to 6 mm there was no difference in pocket reduction maintenance. For attachment there was no difference in 1 to 3 mm probing depths and in 4 to 6 mm pockets, lower gingivitis scores had better gain the first 2 years but thereafter no difference was recorded. For 7 to 12 mm pockets, the lower gingivitis scores seemed to result in better probing levels and attachment gain for the first 3 years but this was not maintained throughout the experiment. The severity of gingivitis did not affect the maintenance of pocket depth reduction or clinical attachment levels.

**Gothenburg Studies.** Lindhe et al. (1982A) reported results of a 2-year study of 15 patients comparing S/RP to modified Widman surgery. Mutilated teeth were included in this study. Patients with advanced periodontal disease were entered into a split mouth design to compare the results of subgingival debridement performed in conjunction with a modified Widman flap or scaling and root planing alone. Scaling and root planing took 6 to 8 hours over a 4-week period. Oral hygiene and the gingival condition in both groups improved significantly. Both treatments resulted in a decrease in probing depth. Initial values were 4.2 and 4.1 mm and decreased to 2.4 and 2.5 (surgery) and 2.9 and 2.8 mm (no surgery). Attachment levels improved following non-surgical therapy at 6 and 12 months, but at 24 months returned to baseline values. Surgical treatment resulted in a slight loss of attachment of 0.3 mm. When comparing single-rooted to multi-rooted teeth, there was a trend for slightly better results for single-rooted teeth. These similar results can be maintained over time in patients with proper oral hygiene levels.

Lindhe et al. (1982B) in another report from the previous study determined the critical probing depth for S/RP and modified Widman surgery. Probing depths shallower than the critical probing depth tend to lose attachment following the procedure. The results showed that the critical probing depth for the S/RP group was 2.9 mm  $\pm$  0.4 and for the MWF group was 4.2 mm  $\pm$  0.2 which indicates that in patients with a large number of shallow probing depths, a non-surgical approach is preferable, while in patients with a large number of pockets  $> 4.2$  mm, surgical treatment may result in more gain of attachment. The results also showed that the level of oral hygiene established during healing and maintenance is more critical for the resulting probing depths and attachment levels than the mode of treatment used.

Lindhe et al. (1984) reported 5-year results of a continuation of the previous study. The results showed that patients who maintained good oral hygiene had more reduction in probing and a greater gain in attachment than patients who failed to perform good plaque control, indicating that the patients' self-performed plaque control had a decisive influence on the long-term effect of treatment. Sites with initial probing depth exceeding 3 mm responded equally well to non-surgical and surgical treatment.

**Aarhus Studies.** Isidor et al. (1984), in a 6-month study on single-rooted teeth, compared 3 treatments utilizing a split-mouth design: S/RP versus modified Widman surgery versus reverse bevel flap. Seventeen (17) patients were treated for advanced periodontitis. One side of both the maxilla and the mandible were treated with modified Widman flap. On the other side, one quadrant was treated with reverse bevel flap surgery without osseous recontouring, and the last quadrant was treated with S/RP alone. Patients were recalled every 2 weeks, and examination was performed at 3 and 6 months after the completion of treatment. At 6 months S/RP resulted in considerable reduction in pocket depth, but more shallow pockets were obtained following surgical treatment. Clinical gain of attachment was obtained following all 3 modalities but S/RP resulted in slightly more gain of attachment than the 2 surgical procedures.

Isidor et al. (1985) reported 1-year results of the previous study. Lateral incisors, canines, and premolars in the maxilla and mandible in 16 patients diagnosed with advanced periodontitis were used for study. Each patient was then treated with reverse bevel flap surgery in 1 quadrant, modified Widman flap surgery in 2 quadrants, with the fourth quadrant treated with S/RP. They were then recalled every second week for professional toothcleaning. The plaque index and bleeding on probing were assessed prior to and 3, 6, and 12 months after treatment. Probing depths and clinical attachment levels were assessed prior to and 1 year after treatment. Radiographs were taken using the bisecting angle technique before and 1 year after treatment, and the bone level was expressed as a percentage of the distance from the apex of the tooth to the normal bone level. Angular bony defects corresponding to 15% or more of the distance between the normal level of the bone and the apex of the involved tooth were located. The results of this study indicate that when comparing modified Widman flap surgery, reverse bevel flap surgery, and S/RP for regeneration of alveolar bone, only the modified Widman flap surgery resulted in significant coronal regrowth of bone in angular bony defects.

Isidor and Karring (1986) reported 5-year results of the previous studies. Sixteen (16) patients with advanced periodontitis were subjected to supra- and subgingival scaling and oral hygiene instructions. This was followed by modified Widman flap, reverse bevel flap, or S/RP. Patients were then recalled regularly for the next 5 years. Surgical and non-surgical treatment resulted in pocket reduction which was maintained over the 5 years. All methods were effective in halting the progression of periodontitis. No correlation was found between oral hygiene and recurrence of periodontitis, suggesting subgingival scaling at frequent recalls is an important factor in halting the progression of disease.

**Tucson-Michigan-Houston Studies.** These studies were conducted in a private practice setting in Tucson, AZ.

The results reported are essentially the same as those reported by the university studies, thus confirming the validity of university research and its applicability to the private practice setting.

Becker et al. (1988) reported 1-year results of a study comparing S/RP, modified Widman surgery, and osseous surgery utilizing a split mouth design. The study population consisted of 16 patients with 2 or more sites with  $\geq 6$  mm of clinical attachment loss in the posterior dentition. All patients had a baseline examination including the plaque index, gingival index, probing depth, clinical attachment levels, mobility, and furcation status. The probing depths were classified as 1 to 3 mm; 4 to 6 mm; or  $\geq 7$  mm. The clinical attachment level measurements were classified as 0 to 2 mm; 3 to 5 mm; and  $\geq 6$  mm. Quadrants were randomly assigned to 1 of 3 treatment groups: scaling and root planing, modified Widman flap surgery, or osseous surgery. At 1 year post-treatment, osseous and modified Widman surgery had significantly greater probing reduction when compared to scaling and root planing. For pockets  $\geq 7$  mm, osseous and modified Widman surgery had significantly greater reduction when compared to scaling and root planing. For pockets 1 to 3 mm, osseous surgery had significantly greater clinical attachment loss when compared with scaling and root planing. The results indicate that at 1 year, scaling and root planing, osseous surgery, and the modified Widman procedure were equally effective in treating moderate to advanced periodontitis.

Kerry et al. (1990) reported 5-year probing depth results of the previous study. Sixteen (16) patients with moderate periodontitis were treated in private practice by periodontists highly competent in performing scaling and root planing, modified Widman flap, and osseous surgery. Patients were evaluated for 5 years. At the 5-year evaluation, plaque and gingival indices were reduced and maintained throughout the study with no difference between treatment methods; 1 to 3 mm probing depths increased insignificantly but were stable at 3 years; 4 to 6 mm pockets were reduced significantly, but diminished over time. There was a difference between scaling and root planing compared to osseous surgery at 3 and 4 years, but not at 5. Similar trends were found for  $\geq 7$  mm pockets. All 3 procedures reduced pocket depth significantly, with no difference between procedures at 5 years.

Becker et al. (1990) reported 5-year attachment level and gingival recession results of the previous studies. Sixteen (16) patients were treated for moderate periodontitis with either scaling and root planing, modified Widman flap, or osseous surgery. Evaluation was made after the hygienic phase, postsurgery, 6 weeks, 6 months, and at yearly intervals for 5 years. Pockets 1 to 3 mm showed significant loss of attachment; 4 to 6 mm pockets, as well as  $> 7$  mm pockets, showed an insignificant gain of clinical attachment with no difference among procedures. All procedures pro-

duced significant recession postsurgery. It was concluded that all techniques behave similarly regarding clinical attachment levels and gingival recession.

**Nebraska Studies.** Kaldahl et al. (1988) reported 2-year results of a split mouth design study of multi-rooted teeth that compared supragingival scaling to subgingival scaling to modified Widman surgery to osseous surgery. Eighty-two (82) patients with moderate to advanced periodontitis had each of 4 quadrants randomly assigned to receive coronal scaling (CS), subgingival scaling and root planing (RP), root planing plus modified Widman flap (MW), flap with osseous resection (FO). Approximately 20% of the CS teeth were retreated. The FO group showed the greatest reduction in probing depth followed by MW, RP, and CS. In deep sites MW, RP, and FO demonstrated the largest gain in attachment while CS was the least.

Kaldahl et al. (1990) reported 2-year results of the previous study that compared the site response. Eighty-two (82) patients with moderate to advanced periodontitis were treated in a split mouth design with coronal scaling (CS), root planing (RP), modified Widman flap (MW), and flap with osseous resection (FO), followed by maintenance treatment for 2 years. Four tooth/site groupings were evaluated: 1) interproximal sites of single-rooted teeth (T1); 2) facial and lingual sites of single-rooted teeth (T2); 3) non-furcation sites of molar teeth (T3); and 4) furcation sites of molar teeth (T4). The sites were further subdivided by their initial probing depth severity (1 to 4 mm, 5 to 6 mm, and  $\geq 7$  mm). The results showed that single-rooted sites  $\geq 5$  mm had a greater mean probing depth reduction and greater probing attachment gain than did the molar sites. Furcation sites showed a greater increase in probing depth and loss of attachment during the 2 years of maintenance. No therapy had a distinct advantage over another in enhancing the relative response of a particular tooth/site group to the other groupings.

Kalkwarf et al. (1992) reported 2-year results of the 2 previous studies that analyzed patient preference of treatment method. Seventy-five (75) patients were evaluated using an interview after 3 years of maintenance care. Each quadrant in each subject was randomly assigned to 1 of 4 types of periodontal therapy: 1) coronal scaling (CS); 2) CS plus subgingival scaling and root planing (RP); 3) CS/RP followed by modified Widman surgery (MW); or 4) CS/RP followed by flap with osseous resectional surgery. During the hygienic phase of therapy, patients were instructed in plaque control and teeth were instrumented with scalers and curets. Maintenance therapy was performed at 3-month intervals by a dental hygienist. At the conclusion of 3 years of maintenance care, a 7 question interview was conducted with each patient to obtain perceptions regarding the results of therapy in each region of their mouth. The results of this study indicate that the ability of the patient to cope with post-therapy sequelae following either coronal scaling, root

planing, modified Widman surgery, or flap with osseous resectional surgery is not significantly different.

**Loma Linda Studies.** The following may be the only study in the periodontal literature that evaluates the separate effects of oral hygiene and S/RP. Most studies evaluate the combined effect. Cercek and coworkers evaluated the separate effect of: 1) supragingival plaque control; 2) subgingival plaque control; 3) S/RP.

Cercek et al. (1983) reported results of a 2-year study that compared supragingival plaque control to subgingival plaque control to scaling and root planing. Seven patients with chronic periodontitis were monitored during 3 phases of treatment: 1) tooth brushing and flossing; 2) Perio-Aid used subgingivally; and 3) subgingival debridement. Plaque scores ranged from 38 to 99% with a mean of 74% at the initial exam. These scores were reduced to 5 to 15% and were maintained throughout the study. The mean bleeding score of 71.7% was reduced to 40.9% in Phase I, no change in Phase II, and reduced to 23% in Phase III. Deeper sites showed more bleeding than shallower sites throughout the study. The mean probing depth of 4.4 mm was reduced to 4.0 mm in Phase I, no improvement in Phase II, and reduced to 3.2 mm after instrumentation. Probing attachment level showed a slight loss through Phase II, but improved attachment levels were found after instrumentation. An increasing gingival recession was noted during the study. Minimal effect was derived from patient-performed plaque control, whether supra- or subgingival. The bulk of the effect was derived from professional subgingival instrumentation (S/RP).

Badersten et al. (1981) in a 13-month study of patients with moderate periodontitis compared the effect of hand versus ultrasonic instrumentation on attachment levels of single-rooted teeth. Incisors, canines, and premolars in 15 patients with moderately advanced periodontitis were treated by hand and ultrasonic non-surgical therapy. Improvements in plaque scores, bleeding on probing, decreased probing and attachment levels were similar for both treatment methods. It was shown that shallower sites had a slight loss of attachment while deeper sites showed some improvement.

Badersten et al. (1984A) reported 24-month results of a study comparing hand to ultrasonic instrumentation in patients with severe periodontitis. Sixteen (16) patients with severely advanced periodontal disease were treated by hand or ultrasonic non-surgical therapy. Comparable results were obtained by both methods. It was shown that the deep probing depths could be successfully treated non-surgically based on probing depth, probing attachment levels, bleeding on probing, plaque, and gingival recession. It was shown that shallower sites were at risk of losing attachment, while the deep sites were more likely to gain attachment. Deeper residual probing sites were more likely to bleed on probing.

Badersten et al. (1984B) compared the effect of a single

session of S/RP to repeated sessions of S/RP. Incisors, canines, and premolars were studied in 13 patients with severe periodontitis. Teeth were instrumented using ultrasonic instruments, and repeated instrumentation in one side of the jaw was performed after 3 and 6 months. A gradual and marked improvement took place during the first 9 months. No differences in results could be observed when comparing the effects of a single versus repeated instrumentation. Deep periodontal pockets in incisors, canines, and premolars may be treated by plaque control and one episode of instrumentation.

Badersten et al. (1985A) reported a study of the effect of operator variability on the results of the scaling and root planing procedure. Twenty (20) patients whose dentition displayed generalized severe periodontal destruction were selected for the study. The incisors, canines, and premolars in either the maxilla or the mandible were studied. The periodontal pockets were debrided using either hand and/or ultrasonic instruments under local anesthesia by a periodontist or by 1 of 5 dental hygienists. A split mouth design was used with measurements of dental plaque, bleeding on probing, probing depth, and probing AL recorded at the initial exam and at every third month by an examiner not involved with treatment. The results indicate that deep periodontal pockets in incisors, canines, and premolars may be successfully treated by plaque control and one episode of instrumentation and that operator variability between highly skilled clinicians is minimal.

Badersten et al. (1985B) examined patterns of probing attachment loss following scaling and root planing. Incisors, canines, and premolars in 33 patients with generalized periodontal destruction were studied for patterns of probing attachment loss. Patients received supra- and subgingival debridement after oral hygiene instructions, and were followed for 24 months. Measurements were made every third month and 7 patterns of probing attachment were identified. Seventy-three percent (73%) of sites showed a gradual change. Seventeen percent (17) showed an early loss followed by a stabilization of attachment levels. Shallower sites showed a pattern of early loss followed by stabilization while deeper sites showed a gradual loss.

## SUMMARY

Non-surgical therapy is an effective method of periodontal therapy. When proper results are not achieved, surgical treatment should follow. Some guidelines are furnished by Lindhe et al. (1982B) in the critical probing depth study.

All research groups found non-surgical therapy to be effective in molar and nonmolar teeth, in shallow and deep sites and whether the study was conducted in a university or private practice setting.

Repeated instrumentation was of little benefit because calculus was often missed on the second attempt for the same reason it was missed the first time.

The primary caveat with non-surgical therapy is that

there are sites and even patients where it may not be effective. This must be recognized at the reevaluation appointment and appropriate therapy, probably surgery, should be instituted.

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## Section 2. Microbiologically Monitored and Modulated Periodontal Therapeutics

### INTRODUCTION

In the late 1970s and early 1980s, a non-surgical approach to periodontal therapy was developed and introduced by Dr. Paul Keyes (Keyes et al. 1978A, 1978B, 1982 and 1985). Microbiologically monitored and modulated periodontal therapeutics (MMPT) were described as a method of identifying therapeutic objectives and targets. The treatment was to be predictable, based on an antimicrobial approach. Whenever therapeutic endpoints were not attained, adjustments in therapy (additional S/RP, irrigation, systemic antibiotics, surgery) were to be used. The procedural steps of MMPT include: 1) clinical examination and microbial assessment consisting of phase contrast microscopic examination of subgingival plaque obtained from 2 or 3 of the most severely diseased sites using a sterile curet. Health and disease were distinguished by the presence of motile bacteria and > 125 white blood cells (WBC) per field; 2) patient education involving phase contrast visualization of the plaque samples on a TV monitor; 3) professional treatment including instrumentation of the teeth (without anesthetics) and irrigation with an antimicrobial solution (chloramine T, a topical sulfonamide agent with hypochlorite action); 4) patient training in oral hygiene measures including use of antimicrobial substances mixed into a thick paste (hydrogen peroxide, sodium bicarbonate, and salt water delivered by an irrigation device); 5) reevaluation including microbiological monitoring and clinical examination; and 6) recall for microbiologic monitoring and for areas of unresolved disease modulation of therapy in the form of additional S/RP, irrigation, systemic antibiotics (usually tetracycline or metronidazole), and surgery if antimicrobial therapy fails.

The rationale for the technique is based on the concept that certain bacterial complexes (motile forms and spirochetes) are not compatible with health. These bacterial populations can be prevented or suppressed by appropriate therapy and when controlled, progressive destruction abates. Motile bacteria, spirochetes, and WBCs can readily be detected by phase contrast (PCM) or darkfield microscopy (DFM). Keyes used non-dispersed samples to preserve colony characteristics and architecture, which were examined by PCM and assigned a value (+, ++, +++, +++++).

In an attempt to validate the use of PCM, Keyes and Rams (1983) studied several groups of subjects without

controls. Healthy sites had no spirochetes, large motile rods, brush forms, or protozoa. Non-motile complexes of cocci and filamentous forms or corn-cob formations were seen. WBCs were present in low numbers (< 5/field). Gingivitis cases had large numbers of smaller rods and cocci, no protozoan species, and few WBCs. Severe periodontitis patients harbored large numbers of spirochetes and motile rods that were organized into brush forms or rosettes. Also present were *Entamoeba* and *Trichomonas* species and large numbers of WBCs (> 125/field). According to MMPT, floras associated with health and disease may be distinguished on the basis of bacterial type, number, and organization, coordinated behavior between organisms, and the inflammatory potential as indicated by the number of leukocytes present. The authors believe that MMPT may help identify persons at risk of developing destructive periodontal disease.

Rams et al. (1985) studied 47 adults with advanced periodontal disease without controls. Long-term patient followup after 3 and 6.5 years of treatment via MMPT showed tooth mortality of 0.6%, a decrease of bleeding on probing from 41% to 1.3%, and slight pocket depth reduction for pockets > 3 mm. It is significant that 46/47 subjects proved "refractory" to the Keyes theory, requiring adjunctive systemic antibiotics, often on multiple occasions.

### CHEMICAL AGENTS OF MMPT

Sodium bicarbonate was evaluated in a study by Newbrun et al. (1984) which also determined the in vitro effectiveness of sodium fluoride and magnesium sulfate against 11 oral microorganisms. They found that subgingival microbes (except *F. nucleatum* and *P. gingivalis*) were inhibited at lower salt concentrations than supragingival bacteria. The bicarbonate ion seemed to be responsible for inhibiting bacterial growth. Bactericidal concentrations of sodium bicarbonate required 30 to 120 minutes contact to kill 99% of the bacteria. Although sodium bicarbonate is not as potent as sodium fluoride, sodium lauryl sulfate, or chloramine T, it is readily available, inexpensive, and safe. The ability to retain bactericidal concentrations in the subgingival environment for 30 to 120 minutes is questionable.

The use of sodium bicarbonate combined with hydrogen peroxide was evaluated by Fletcher et al. (1984), who reported that several *Streptococci* and *Mycoplasma* were susceptible to 0.5% hydrogen peroxide alone. The combination of sodium bicarbonate with the peroxide diminished the antibacterial activity from 2 to 16X, with 5% sodium bicarbonate failing to inhibit these organisms.

Weitzman et al. (1984) questioned the chronic use of hydrogen peroxide due to potential carcinogenicity, co-carcinogenicity, and tumor promotion potential that has been reported in experimental animals.

Keyes and Rams (1984) studied the potential antibacterial effects of periodate salts on microbes obtained from one periodontitis patient. These salts are oxidizers which release

iodine. In vitro exposure to periodate salts for 1 minute eliminated all spirochetes and rods.

## REVIEW ARTICLES

Greenwell and Bissada reviewed the controlled evaluations of Keyes' method and concluded there was no scientific evidence for any effect beyond that obtained with conventional non-surgical therapy. Microscopic evaluation of bacterial morphotypes had not been shown to provide clinically useful information in terms of periodontal diagnosis. The frequent use of antibiotics was considered generally unnecessary and was not recommended on the broad scale advocated by Keyes.

To review the role of microscopic monitoring in detecting periodontal disease, Greenstein and Polson (1985) discussed several articles. Generally, microscopic monitoring can demonstrate differences in the subgingival microflora, but it is not clear whether the organisms monitored are involved in the pathogenesis of periodontitis or are merely co-habitants of deeper pockets. It is impossible to determine threshold values of bacteria that initiate disease, and the ability to predict attachment loss based on spirochetes is not consistent. Host susceptibility may be a more important factor than the determination of bacterial morphotype. Until the relationship between organisms and pathogenesis has been clarified, chairside microscopic monitoring of bacterial populations has not been shown to provide clinically useful information and must be interpreted cautiously.

Valentine (1985) reviewed literature related to each step of the Keyes' technique and concluded that the benefits of the technique are almost exclusively derived from the detailed oral hygiene procedures and root planing. Little or no sound evidence was found to support the use of the antimicrobials during any step of the treatment in adult periodontitis.

Omar and Newman (1986) discussed several inherent problems associated with the various stages of darkfield microscopy. Problems in sampling include: 1) variability between and within individuals of morphotype counts from sites with comparable pocket depths; 2) contamination of the sample; 3) reduction of sample volume after scaling; and 4) difficult interproximal access. Problems in dispersion include: 1) contamination; 2) uneven distribution of different morphotypes; and 3) destruction of delicate organisms. Problems in slide preparation include contamination, logistical difficulties, and time of cell viability. Problems in identification and counting include: 1) Brownian movement versus true motility; 2) fragmented bacteria; 3) confusion of *Campylobacter* with spirochetes; and, 4) confusion of flagella with flagella-like structures. Problems in morphotype grouping include lack of motility in many periodontopathogens or inability to consistently demonstrate motility in all motile species.

The current position of the Academy regarding MMPT is outlined in a 1994 position paper (American Academy

of Periodontology). The Keyes' technique consists of current controversial periodontal therapy to which microscopic monitoring, increased use of systemic antibodies, and use of local chemical agents have been added. These additional approaches do not appear to offer increased benefits over conventional periodontal therapy for cases of adult periodontitis and may, in certain situations, offer substantial negative effects. New technologies for specific bacterial identification, new diagnostics, and new chemotherapeutic agents offer great possibilities for enhanced management of periodontal diseases. Such technologies must be assessed in controlled, long-term studies to determine added advantages over existing conventional techniques prior to routine use.

## SHORT-TERM STUDIES (6 MONTHS OR LESS)

Cerra and Killoy (1982) reported on a 21-day study using a split-mouth design and no S/RP. Four patients with 4 to 7 mm pockets were examined for microbial flora on days 1 and 21 of this experiment. They were taught the Bass method of brushing and instructed to apply sodium bicarbonate and 3% hydrogen peroxide to one side of the mouth and fluoridated toothpaste to the other daily for 1 minute. There were no statistically significant differences between test and control sides. Pocket depth for the test on day 1 was 5.19 and at day 21 was 4.19; for the controls, it was 4.75 on day 1 and 3.88 on day 21. Bacterial counts were not reduced for any morphotypes for either test or control sides.

Greenwell et al. (1983) compared the effect of Keyes' method of oral hygiene with conventional oral hygiene during an 8-week study, using a split-mouth design. Eighteen (18) patients were divided into 2 equal groups, 9 with moderate-severe periodontitis and 9 who had previously received pocket elimination surgery. Based on PI, GI, gingival fluid flow, darkfield microscopic counts, probing depth, and bleeding on probing, no significant differences were seen between the 2 oral hygiene methods. The authors stated that patients treated surgically had significantly better periodontal health than those treated non-surgically.

Greenwell et al. (1985) compared the Keyes' oral hygiene technique to conventional oral hygiene in non-treated subjects, those receiving scaling and root planing only and patients treated surgically. Based on clinical and microbiological indicators, results revealed no statistically significant differences between Keyes' technique and conventional oral hygiene in areas treated with a single session of S/RP. In untreated areas (no S/RP) Keyes' method was more effective than conventional oral hygiene. Surgical status was the most significant factor in reducing clinical and bacteriological indicators. The results indicated that the Keyes' technique should not be relied on to control the pathogenic subgingival microflora.

West and King (1983) compared toothbrushing with sodium bicarbonate-hydrogen peroxide (Keyes) to toothpowder and water to determine reduction of pocket suppuration

and darkfield bacteria counts. After S/RP in each group, suppuration was reduced about 70%. The sequential or concurrent mode of therapy had no impact on treatment results.

Wolff et al. (1982) reported on a 2-group, 62-patient, 16-week study which evaluated the effectiveness of the antimicrobial home treatment advocated by Keyes using phase contrast microscopy. No differences were detected between conventional oral hygiene measures and those associated with the Keyes' technique at 8 and 16 weeks.

In a study by Rosling et al. (1982), 20 patients with moderate to severe periodontitis were given oral hygiene instructions and a supragingival cleaning, and were then randomly assigned to test or control groups. Half the mouth was subgingivally scaled under local anesthesia. The test group received a bicarbonate-peroxide mixture professionally applied subgingivally and irrigation with Betadine. Controls were irrigated with saline. For 3 months, each group received a professional cleaning every 2 weeks. The PI scores were similarly reduced for both groups. The GI scores were lower in the scaled than the unscaled quadrants at 3 and 6 months. Probing depths in 4 to 6 mm pockets were reduced in scaled areas of tests and controls. Gains in clinical attachment level (CAL) were greater in the scaled test sites than in scaled controls. The reduction in bacterial counts was greater than controls in both scaled and unscaled quadrants. The professional application of the baking soda-peroxide mixture differed from the typical patient application and may have accounted for the significant differences found in this study.

### LONG-TERM STUDIES (1 TO 4 YEARS)

Pihlstrom et al. (1987) studied 231 patients who received scaling and root planing and were then assigned to 4 groups: 1) conventional oral hygiene; 2) conventional oral hygiene plus microscopic viewing of subgingival microbial flora; 3) the use of sodium bicarbonate, hydrogen peroxide, and sodium chloride (regimen S/P); and 4) S/P plus microscopic viewing of the subgingival microbial flora. After baseline clinical data collection and plaque sampling were completed, subjects in all groups received a professional scaling, root planing, and tooth polishing. Microbial and clinical data were collected at baseline, and at 8, 16, and 24 months from selected teeth. Clinical results showed that both procedures effectively reduced clinical signs of disease when combined with professional care, with no difference between the two regimens.

In a report of the microbiological results, Wolff et al. (1987) noted that there was no effect on spirochetes observed between subjects who did or did not view their plaque microscopically, when sites were stratified into molars and non-molars. There was no significant difference between frequency of reinstrumentation between sites monitored clinically or microscopically.

A study of patient compliance results by Bakdash et al. (1987) indicated that 23% of patients using conventional

oral hygiene and 43% on the Keyes' regimen cited inconvenience as the reason for non-compliance; 74% of conventional and 58% of Keyes' groups used the assigned regimen 4 to 7 days per week. There was no evidence that microscopic viewing of plaque was a significant motivating factor.

In a followup study, Wolff et al. (1989) evaluated 171 subjects. Higher levels of compliance were observed in the groups using conventional oral hygiene procedures. There were no significant differences in clinical health between the salt and peroxide as compared to the conventional oral hygiene groups.

Rosling et al. (1983) reported on 20 patients who received supragingival scaling in all 4 quadrants, then subgingival scaling and root planing in 2 quadrants only. The test group received professional application of a mixture of  $H_2O_2$ -NaCl-NaHCO<sub>3</sub> which was irrigated by a water solution of Betadine (test group); the control group was irrigated only with saline. Home care instruction included the use of the mixture by the test group and the use of a regular toothpaste by the control group. Parameters studied included: plaque index, gingival index, probing depth, attachment levels, subtraction radiography for changes in bone density, and microbiological examination. The 2-month results indicated that professional and personal use of the mixture will significantly enhance the microbiological and clinical effects of periodontal scaling and root planing. The professional application of the baking soda-peroxide mixture differs from the typical patient application and may account for the significant differences found in this study.

Rosling et al. (1986) studied the use of topical antimicrobial therapy and diagnosis of subgingival bacteria in the management of inflammatory periodontal disease. Sixty (60) patients, diagnosed with moderate to severe periodontitis, were included in 3 treatment studies. All patients (10 per test and control) were examined at baseline and at 3, 6, and 12 months after completion of treatment. Clinical parameters assessed were the PI, GI, PD, and clinical attachment level (CAL). Standardized radiographs were taken to detect changes in alveolar bone mass and microbiological samples were collected from diseased areas and assessed for the occurrence of *A. actinomycetemcomitans* and *P. gingivalis*. Study A compared subgingival scaling plus a topical antimicrobial to subgingival scaling alone. Study B assessed the effects of scaling alone, scaling plus surgery, and scaling, surgery, and topical administration of a 0.5% Betadine solution. Areas with gain of CAL demonstrated BOP in 24% of sites while the frequency of no bleeding units in areas with loss of CAL was 81%. *A. actinomycetemcomitans* and *P. gingivalis* were identified in 5 of the 8 progressing periodontitis lesions. In contrast, these organisms were identified in only 8 of the 28 lesions with no apparent change in the CAL. Neither of the organisms was present in the sites showing a gain in CAL. The results indicate a role for topical microbial agents as an adjunct to



mechanical subgingival debridement in the treatment of adult periodontitis. The professional application of baking soda-peroxide mixture differs from the typical patient application and may account for the significant differences found in this study.

## SUMMARY

In summary, MMPT has no benefit beyond that obtained from S/RP alone. The only controlled studies that have shown a significant difference between conventional and Keyes' regimens employed professional application of the baking soda mixture. Results were similar between short-term and long-term studies and between 2-group and split-mouth designs. The literature is in agreement that Keyes' oral hygiene agents have no benefit beyond that of conventional methods. Microscopic diagnostic methods provided no advantages over conventional methods.

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