For Post-Graduate Examinations

Supportive Periodontal Therapy
A Comprehensive Review

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Supportive Periodontal Therapy : A Comprehensive Review

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Dedicated To

All the post graduate dental students!

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Preface

Supportive periodontal therapy (SPT) is the term given to care and proper maintenance of the patient after completion of periodontal therapy. One of the causes of failure of periodontal therapy is the inadequate follow-up. Hence, patients as well as specialists should be made to understand the significance of supportive periodontal therapy. The purpose of this book is to make the dental professionals/post-graduate students aware of the facts regarding the importance and the protocols of SPT.

It is my great privilege to introduce my new textbook "Supportive Periodontal Therapy : A Comprehensive Review", and I hope that it will be useful to the post-graduate students as well as dental professionals.

Acknowledgement

I acknowledge and appreciate my staff and post-graduate students for their complete support in writing this book.

Contents

Chapter 1

Introduction to Supportive Periodontal Therapy

Periodontitis is a microbial infectious disease and is characterized by the presence of gingival inflammation, periodontal pocket formation, and loss of connective tissue attachment and alveolar bone around the affected teeth.[1] The aim of periodontal therapy is to protect and maintain the patient's natural dentition over their lifetime for optimal comfort, function and aesthetic appearance.[2] Periodontal therapy includes surgical and non-surgical procedures. Once the periodontal therapy is completed, patients should be placed on a schedule of periodic recall visits for supportive care to prevent the recurrence of the disease. Recurrence of periodontal disease can occur due to improper oral hygiene habits, inadequate subgingival removal, because of the microscopic nature of the dentogingival unit healing after periodontal treatment etc. Hence proper treatment should be rendered so that the recurrence of disease doesn't occur. Transfer of the patient from active treatment status to a maintenance care program is an ultimate step in total patient care that requires time and effort on the part of dentist, staff and patient. Thus, the maintenance phase has been considered as the cornerstone of successful periodontal therapy.[1]

Clinical trials on the long-term effects of treatment of periodontitis have clearly demonstrated that post-therapeutic professional maintenance care is an integral part of the treatment.[2] Patients who are not maintained on a supervised recall program subsequent to active treatment show obvious signs of recurrent periodontitis (e.g. increased pocket depth, bone loss, or tooth loss).[3,4,5] One study found that treated patients who do not return on regular recall basis are at 5.6 times greater risk for tooth loss than compliant patients.[6] Another study showed that patients with inadequate maintenance care after successful regenerative therapy have a 50-fold increase in risk of attachment loss when compared with those who have regular recall visits.[7] Studies[8-10] have indicated patients who return for their regular periodic visits of scaling, root planning, oral hygiene reinforcement, and disease reassessment demonstrate better periodontal health and a better prognosis in the long term than those patients who do not return for these appointments.

Treatments with long term maintenance programs following active therapy,[11] once termed maintenance is called as Supportive Periodontal Therapy (SPT) according to 5th American Academy of Periodontology (AAP), 1986.[12] In 1989 the World workshop

in clinical periodontics described the term 'supportive periodontal treatment' (SPT)[13] and in 2003 AAP, position paper termed it as Periodontal Maintenance Therapy.[1]

An old Chinese proverb holds true explaining the importance of the interval treatment sessions in Supportive Periodontal Treatment–"It is better to take many small steps in the right direction than to make a great leap forward only to stumble backward."

A successful treatment of periodontal disease requires a positive program directed at maintaining and improving the results of treatment as well as preventing the development of new disease. Hence supportive periodontal treatment is performed by a dentist, although components of supportive periodontal treatment can be executed by a dental hygienist under the supervision of the dentist. Supportive periodontal treatment should include an update of medical and dental history, radiographic review, extra oral and intraoral soft tissue examination, dental examination, periodontal evaluation, removal of bacterial plaque from the supragingival and subgingival regions, scaling and root planing where indicated, polishing of the teeth and a review of the patient's plaque control efficacy and other appropriate behaviour modification.[14,15]

In SPT, periodontal diseases and conditions are monitored, etiological factors reduced or eliminated and continued at periodic intervals for the life of the dentition or its implant replacement.[12] Patient should be informed and explained about the importance of this therapy for management of the disease.[16] This makes the patient to maintain the teeth for their life time which suggests that the evaluation of the efficacy of SPT can be carried out over an extended period.[17] Attempts are being made to individualize and tailor SPT regimen according to the patient's profile and needs i.e. in various clinical aspects like patients with gingivitis, periodontitis, implants and also its role in other different clinical aspects of dentistry. Recent trends also show increased use of antimicrobials as adjuncts to mechanical procedures for controlling the etiologic agents.[16] The term 'supportive periodontal treatment' expresses the essential need for corrective measures to support the patient's own efforts to control the periodontal infections and to avoid re-infection.[18]

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Chapter 2

Aims and Objectives

The prime objective of maintenance care is to secure optimal supra and subgingival plaque control. First by encouraging optimal oral hygiene by the patient, and secondly by professional removal of all supra and subgingival plaque and calculus.[19] The therapeutic objectives of supportive periodontal therapy are: to prevent the progression and recurrence of disease in patients who has been previously treated for gingivitis and periodontitis; to prevent the loss of dental implants after clinical stability has been achieved; to reduce tooth loss by monitoring the dentition; and to diagnose and manage other diseases or conditions found within or related to the oral cavity.[15]

Objectives of supportive periodontal therapy:

1. Preservation of alveolar bone support: as evaluated with radiograph.
    i. Bone height may not only be maintained but also improved when proper maintenance is provided after periodontal therapy.
2. Maintenance of stable clinical attachment levels.
    i. Despite all the variability associated with clinical measurement maintenance of stable clinical attachment levels represents a reasonable clinical indicator to evaluate the stability of results.
3. Control inflammation: without proper maintenance dental plaque will re-accumulate and inflammation would be re-established in periodontal tissues. On the contrary well maintained patient will have low levels of inflammation after therapy.
4. Re-evaluation and reinforcement of proper home care.
    i. Although 3-4 month recall seems to compensate for improper plaque control as far as its effects on clinical attachment levels, the better the oral hygiene the patient performs, the better the possibility of maintaining stable result.
    ii. With training and positive reinforcement the level of plaque control can be improved in most patients, however it may take several sessions with some patients.

Success of Periodontal Therapy

Numerous studies have demonstrated that various surgical procedures are successful in reducing deepened periodontal pockets with minimal or no long-term

loss of attachment.[28,46-49] The key to sustaining the reduced pocket depths once active therapy has been completed is the maintenance phase of treatment.[27,50] In terms of tooth mortality, study done by William Beckar in 1984 says that, population had a mean annual adjusted tooth loss of 0.22 tooth/year. They reported that patients who were treated and maintained had a mean annual adjusted tooth loss of 0.11,[28] while a diagnosed but untreated periodontal population had an adjusted mean annual tooth loss of 0.36.[40] The added impact of maintenance on tooth mortality is important, since a primary goal of periodontal therapy is increasing the longevity of the natural dentition. The unmaintained group in this study had a higher incidence of tooth loss for teeth with a good and questionable prognosis than the previously reported maintained population.[28] The landmark study of Hirschfeld and Wasserman[51] reported their findings on 600 treated and maintained patients over a 22-year period. The mean annual tooth loss was 0.09 tooth/patient.

Low incidence of tooth loss with treatment and maintenance has also been reported by Oliver[52] and McFall.[53] It is interesting that of the 51 teeth which were initially given a "hopeless" prognosis, 34 were present at the second examination. Determining a prognosis for a hopeless tooth is difficult, since such factors as patient comfort, restorative treatment plans and the level of health or disease of adjacent teeth must be considered. Studies of the influence of hopeless teeth on the health status of adjacent teeth are needed. When a comparison was made of changes in the health status of furcations between the unmaintained and the previously reported maintained groups, a worsening of the furcations was apparent for the unmaintained group.[28] Treatment and maintenance appear to have a stabilizing effect on furcations.[28] Similar findings have been reported by Hamp and co-workers,[46] and by Ross and Thompson.[54] Findings were in agreement with those of Nyman et al.[39] in terms of pocket recurrence in treated but unmaintained patients. Ideally, a comparison of probing depths immediately after surgery with those found at re-examination would have been valuable. Since all of the patients in this study had pocket reduction therapy and no maintenance, the recurrence of probing depths to their original levels is not surprising. The recurrence of pocket may be due to gingival swelling and enlargement as a result of inflammation.

Failures of Periodontal Therapy

It is obvious from a number of long- and short- term studies that treatment of periodontal disease including oral hygiene instruction, scaling, root planing and surgery– in order to get access to the root surfaces for proper debridement– can not only arrest the gradual breakdown of the supporting apparatus but, indeed, also result in gain of clinical attachment and re-growth of alveolar bone.[21,46]

It has also become apparent, however, that the long-term success of periodontal treatment is dependent upon the effectiveness of the maintenance care program's subsequent active treatment. Hence, in patients who following completion of surgical treatment are placed on maintenance care which includes recalls every 3 months for

prophylaxis and instruction in home care techniques, the long-term result of treatment seems to be successful. On the other hand in patients who are recalled for maintenance care at a less frequent interval (6-12 months) there is an obvious risk for recurrence of periodontitis.[27,39] Studies by Suomi et al. (1971)[57], Bjorn (1974)[58], Axelsson and Lindhe (1978)[29], Soderhoim (1979)[59] have revealed that traditional dental treatment frequently seems to be directed towards the elimination of symptoms of caries and periodontal disease rather than on the elimination of the cause of the two disorders.

Recent observations by Loe et al. (1978) and Soderhoim (1979)[59] compared to results by, e.g. Bjorn (1974)[58] indicate, however, that the overall standard of oral hygiene in adult populations in Scandinavia has improved and that as a consequence the frequency and severity of caries and periodontal disease are becoming less pronounced. Patients who suffer from advanced periodontal disease are often referred by the general practitioner to a specialist for treatment. As a rule the periodontitis patient is subjected to an elaborate treatment in the specialist's office including periodontal surgery and active maintenance care immediately post-surgically. Subsequently, in most instances, the patients are referred back to the general practitioner for long-term maintenance care.

Sequence of Supportive Maintenance Therapy

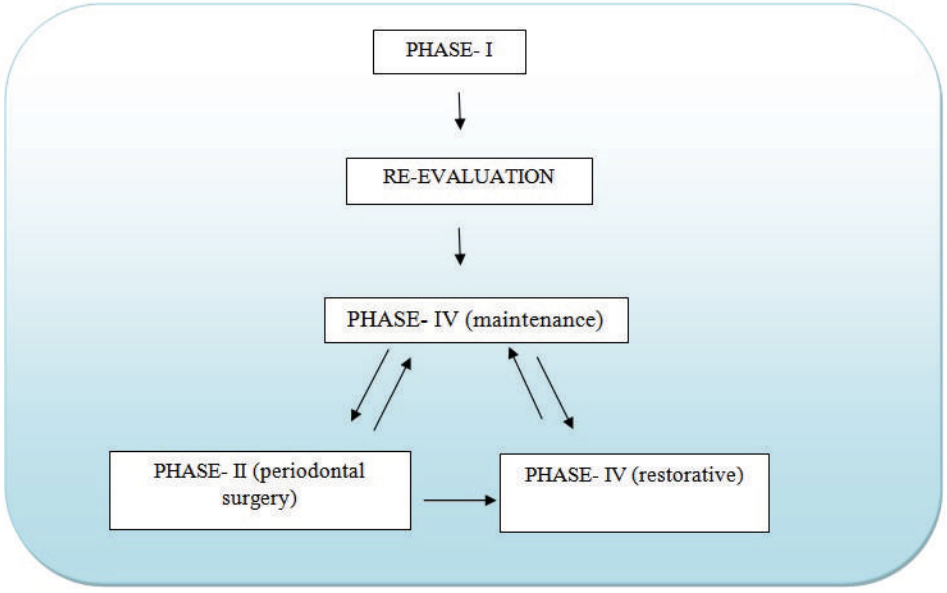

Fig. 1: Sequence of supportive maintenance therapy

© Newman and Carranza's Clinical Periodontology; Thirteenth Edition; FIG. 72.2 Correct sequence of periodontal treatment phases. Page no- 3966

Types of SPT

Schallhorn and Snider (1981)

1. Preventive maintenance therapy
   Periodontally healthy individuals.
2. Trial maintenance therapy
   Mild to moderate periodontitis.
3. Compromised maintenance therapy
   Medically compromised patients where active therapy is not possible.
4. Post-maintenance treatment therapy
   Maintenance for prevention of recurrence of disease.

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Chapter 3

Biologic Basis and Rationale for Periodontal Maintenance

Tooth loss in some periodontal patients has been shown to be inversely proportional to the frequency of periodontal maintenance. Studies have shown the efficacy of periodontal maintenance (PM), and have shown that recurrent periodontitis can be prevented or limited by optimal personal oral hygiene or through periodic periodontal maintenance.[20]

Other studies have shown that those patients who maintain regular periodontal maintenance intervals[3,21-35] experience less attachment loss and lose few teeth when compared with those patients who receive less periodontal maintenance[36-38] or none at all.[39-41] Since patients rarely are completely effective in removing plaque;[42-43] adherences to a periodontal maintenance program reduce the risk of future attachment loss.

Similarly, periodontal maintenance allows for monitoring of dental implants, as well as evaluation of mechanical and biological aspects of implants support and restoration.

Since it is not possible to predict when or if untreated gingivitis will progress to periodontitis, periodontal maintenance provides for periodic monitoring as well as professional plaque removal in patients who have been treated for periodontal disease.[3,37,44]

In one study, the proportion of spirochetes obtained in baseline samples of subgingival flora was highly corresponding with clinical periodontal deterioration over 1 year.[45] However, subsequent reports in the same longitudinal study concluded that the arbitrary assignment of treated periodontitis patients to 3 months maintenance intervals appears to be as effective in preventing recurrences of periodontitis as assignment of recall intervals based on microscopic monitoring of the subgingival flora.[45,39] Microscopic monitoring was found not to be a reliable predictor of future periodontal destruction in patients on 3 months recall programs, presumably because of the alteration of subgingival flora produced by subgingival instrumentation.

In conclusion, there is a sound scientific evidence for recall maintenance because subgingival scaling alters the pocket microflora for variable but relatively long periods.

Optimal Frequency of Supportive Periodontal Care

Periodontal maintenance care demands the periodical presence of the patient in the dental office during the rest of his/her life. However, patient compliance with maintenance

visits is usually would be desirable to establish a compromise; the lowest frequency of maintenance visits compatible with an adequate preservation of periodontal support.

The rationale for 3-month recall intervals for SPT is most likely based on published studies that used 3-4 months intervals as part of study design rather than a result of studies comparing the efficacy and safety of different time intervals for SPT.[47,60-71] Another rationale for short intervals between clinic visits is the understanding that frequent maintenance care is necessary to eliminate/reduce subgingival proportions of pathogens associated with periodontitis. Re-colonization of pathogens in previously treated periodontal pockets occurs quickly if oral hygiene is not properly maintained.[72-74] Therefore, 3-4 months maintenance care intervals have been suggested.[19,75,76] However, several other studies have demonstrated that longer intervals between maintenance care visits can effectively prevent further disease progression. [22,42,77,78]

Axelsson et al.[77] in a 15-year follow up study of 375 adult individuals, demonstrated a low incidence of caries and almost no further loss of periodontal support even though SPT were performed only once or twice yearly for the previous 9 years.

Lindhe et al.[22] using a maintenance program restricted to oral hygiene instruction and supragingival cleaning every 4-6 months found that patients who consistently had a high frequency of plaque-free surfaces showed little evidence of additional loss of attachment. Thus, rigorous oral hygiene, frequent recalls do not appear to be as important as in individuals with inadequate oral hygiene.

There are few studies that have compared the impact of different recall intervals. According to Rosen et al.[79] who studied the effects of 3, 6, 12, and 18 months intervals between supportive recall treatments. With the exception of a trend of some rebounding sites and attachment loss at molar sites with furcation involvement in the 18 months recall group, no differences were found between the groups. The results of this study suggest that recall intervals could be extended to at least 1 year in patients with a history of limited susceptibility to periodontitis.

Factors Affecting Frequency

For patients with gingivitis but with no previous history of attachment loss, maintenance care should be twice a year, whereas for patients with a previous history of periodontitis, studies suggest the frequency of maintenance care should be less than 6 months.[46] Those patients with previous history of chronic periodontitis should be recalled at least 4 times a year, because that interval will result in a decreased likelihood of progressive disease.[37]

Microorganisms level after scaling and root placing return to baseline between 9 and 11 weeks. If the clinician wishes to prevent re-establishment of suspected pathogens, SPT intervals of 3 months or less appear to be required. Compliance of the patient with suggested SPT intervals can affect the success of treatment.

All this data goes to suggest that it is advantages if SPT visits are performed every 3 months. However, this interval should be individualized.[12]

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Chapter 4

Recall Intervals for Various Classes of Recall Patients[80]

MERIN'S Classification	Characteristics	Recall Internal
First year	First year patient– routine therapy and uneventful healing or First year patients– difficult case with complicated prosthesis, furcation involvement, poor crown to root ratio, or questionable patient co-operation.	3 months 1 to 2 months
Class A	Excellent results well maintained for 1 year or more patients displays good oral hygiene, minimum calculus, no occlusal problems, no complicated prosthesis, no remaining pockets, and no teeth with less than 50% of alveolar bone remaining.	6 months to 1 year
Class B	Generally good results maintained reasonably well for 1 year or more, but patient displays some of the following factors: 1. In consistent or poor oral hygiene 2. Heavy calculus formation 3. Systemic disease that predisposes to periodontal breakdown 4. Some remaining pockets. 5. Occlusal problems 6. Complicated prosthesis 7. Ongoing orthodontic treatment 8. Recurrent dental caries 9. Some teeth with less than 50% of alveolar bone support 10. Smoking 11. Positive genetic test.	3 to 4 months

Class C	Generally poor results following periodontal therapy and/or several negative factors from the following list: 1. Inconsistent or poor oral hygiene 2. Heavy calculus formation 3. Systemic disease that pre disease to periodontal breakdown 4. Remaining pockets 5. Occlusal problems 6. Complicated prosthesis 7. Recurrent dental caries. 8. Many teeth with less than 50% of alveolar bone support 9. Smoking 10. Positive genetic test 11. Periodontal surgery indicated but not performed for medical, psychologic or financial reasons 12. Conditions too for advanced to be improved by periodontal surgery. 13. More than 20% of pockets bleed on probing.	1 to 3 months

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Chapter 5

Compliance and its Role in Periodontal Therapy

Definition

Compliance is also called adherence and therapeutic alliance. It has been defined as "the extent to which a person's behaviour coincides with medical or health advice".[81]

Few patients comply completely with professional suggestions. In general, compliance decreases as treatment time or the complexity of the required behavioural changes increases. The less threatening the patient perceives the problem to be, the lower the compliance.

Compliance with appointments can be measured directly– the patients either come in, or they do not. In addition, the patients who clean their teeth will have more periodontal support than those who do not. It is also feasible to measure home care efficiency (by examining for bacterial plaque) and efficacy (by detecting bleeding upon probing, increased probing depth or attachment loss).

Compliance with Suggested Oral Hygiene Regime

The average patient has difficulty in changing oral hygiene habits. Interviews conducted with patients shortly after oral hygiene instruction, have shown high levels of non-compliance.

Many groups have studied methods to improve compliance.

Glavind et al. (1983)[82] found that positive feedback to a group of 63 adults. Lowered plaque and bleeding scores compared with controls. They found that positive feedback lowered plaque and bleeding scores compared with controls. When the feedback was discontinued, the test groups' performance declined.

Schwartz (1962)[83] reported that 2/3rd of the patients who drop out of suggested oral hygiene regimens do so within 3 months. The study suggested that self care is a positive alternative to professional care and that the keys to adequate self care include successful communicated with the patient on the part of the therapist, having the desired skills demonstrated by the patient to the therapist and reinforcing the idea that efficacy is more important than the amount of time spent cleaning.

Compliance with Suggested Supportive Periodontal Treatment Schedules

The first study on the degree of compliance with supportive periodontal treatment was published in 1984 by Dr. Wilson et al.[37] It reviewed all the patients whose progress could be followed after treatment for periodontitis in a private periodontal office; only 16% complied with suggested SPT intervals, 34% never came back for maintenance, and the rest complied erratically. In a follow up study for 5 years, the tooth loss was surveyed (non-compliers were not included). Tooth loss frequency was zero teeth per year for complete compliers and 0.06 teeth per patient per year for erratic compliers.

Johnsson et al. (1984)[42] have a counter point to the need for SPT. In their study, approximately 75% of 44 patients treated for moderate periodontitis saw their dentists only once a year and 20% went twice a year. The authors found that the frequency of visits had no effect on the amount of bleeding on probing. It was concluded that since the patients did not comply with suggested maintenance schedules but still did well with their plaque and bleeding scores, total compliance as a 3-month basis may not be necessary to control the parameters measured. Implicit in this reasoning is the improved oral hygiene along with the scaling and root planing, were responsible for the improvement.

Why do patients fail to comply?

1. According to Farberow N in 1986, it has been suggested that non-compliance with health care recommendations is an indirect self-destructive behaviour.[84] The behaviour of these non-compliance patients is characterized by denial and negligent attitudes towards their illness.
2. Lack of pertinent information.
3. Fear of dental treatment is a major reason for non-compliance. Several approaches have been suggested to diminish this concern:
   i. Use of relaxation and symbolic modelling.
   ii. Group education or videotapes.
   iii. Changing the behaviour of dentists toward patients.
4. Economic problems– In groups with lower socioeconomic status, monetary rewards have been shown to improve compliance. A group of 29 patients in a periodontists' office well studied over a 6-month period for compliance to suggested oral hygiene. Each patient is the test group received a fee reduction if his or her total plaque score was reduced from baseline. Whereas the control groups received education only. Initially, the test group had significantly fewer surfaces with plaque and achieved their goal faster than controls. However, in 6 months the test group had only 13% fewer surfaces of plaque then the control groups and only 19% better than a 3rd groups who were given no education or fee reduction (Iwata B et al 1981).[85]

Generally, patients of lower socio-economic status may be influenced by monetary enticements, whereas higher status patients are more apt to be motivated by education, exercise of practitioner authority, discussion and persuasion.

Possible Methods of Improving Compliance

1. Simplify– The simpler the required behaviour, the more likely it is to be carried out.
2. Suggestions– Accommodate more the suggestions fit the patients' needs, the more likely they are to comply.
3. Remind patient of appointments– Communication is a key factor. Factors that influence breakage of appointments:
   i. Absence of perceived need for visit.
   ii. Absence of designated dental therapist who will treat the patient.
   iii. Age.
   iv. Race.
   v. Psychosocial problems.
   vi. Percentage of previous non-cancelled appointments.

Many of the studies on failed appointments have been done in hospital settings with groups of lower socioeconomic status and may not be applicable to all private practice settings. Appropriate vehicles for appointment reminders include postcards and telephone contact.

4. Keep records of compliance– Efforts should be made to keep up with the patient. This often requires advanced systems, and a computer for appointment control and tracking missed visits. Communication with the patient should be initiated as quickly as possible when non-compliant behaviour is noted. The sooner the patient is contacted after missing the appointment, the more likely they are to keep their new appointment.
5. Inform– Put what is to be said is writing and give a copy to the patient. Telling the patient the causes of the diseases process and their role in its treatment improves compliance.
6. Provide positive reinforcement– Most patients do better when positive feedback is given when compared with a more negative approach to their compliance problem. No one enjoys criticism, but positive reinforcement and constructive guidance can be helpful.
7. Identify potential non-compliers– Discuss the problems that this may create for the patient before therapy begins. Then track these patients closely.
8. Ensure the dentists involvement– In some cases, dentists are more likely to encourage compliance than the dental hygienists.

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Chapter 6

The Dental Professionals' Role in Supportive Periodontal Therapy

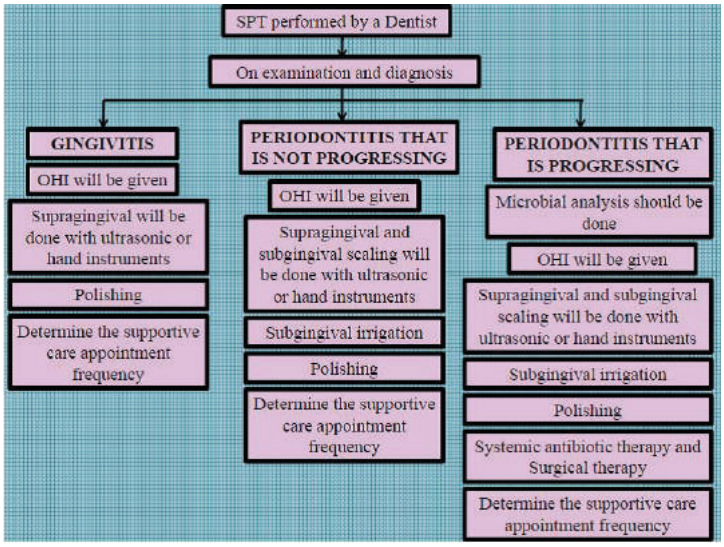

Fig. 2: (At maintenance care appointments, dental professional not only should target pathogens residing in subgingival and supra gingival sites, but also should treat periodontopathic microorganisms on the tongue and other oral sites.)

©Katta Rc, Chava Vk, Nagarakanti S. Supportive periodontal therapy-a review. Annals & Essences Of Dentistry. 2016 jan 1;8(1). Pg no-5c, flow chart- 1

Debridement

Periodontal maintenance therapy by the dental professional includes mechanical debridement and administration of antiseptic agents.

Mechanical debridement might be performed only on surfaces with hard deposits since instrumentation, particularly in probing depth of 3 mm or less, can cause loss of tooth substance or periodontal attachment.[86]

In patients who exhibit supragingival calculus formation, ultrasonic debridement is recommended, because it is faster than debridement with hand instruments and may

use as an irrigant 10% povidone-iodine antiseptic (such as Betadine, Moore Medical Corp, which contains approximately 10% povidone-iodine and 1% free iodine) diluted with nine parts water.[87]

Because of difficulty in observing subgingival hard deposits and lack of tactile sensation by ultrasonic scalers hand instruments are often used for final root preparation.

Nosal and colleagues[88] conducted a study of subgingival debridement and found that an irrigant delivered through ultrasonic scaling tips demonstrated complete pocket penetration in 86% of sites ranging from 3 to 9 mm in depth. Rosling and colleagues[89] demonstrated the benefits of using povidone-iodine in conjunction with ultrasonic scaling of periodontitis lesions.

Subgingival Irrigation

Subgingival applications of various chemotherapeutic agents have been used as an adjunct to non-surgical periodontal treatment and preventive periodontal therapy. The main objective of supragingival irrigation is to remove microbe's coronal to the gingival margin, which is primary etiological factors for the development of gingivitis or progression of existing gingivitis, thereby preventing gingivitis or decreasing existing gingival inflammation. In contrast, the biologic rationale for performing subgingival irrigation is to reduce subgingival microbiota quantitatively that initiates and progress periodontal diseases. Routine maintenance scaling cannot completely remove subgingival pathogenic bacteria;[90] hence it may be augmented by irrigation with a cannula. Preferably after scaling and root planing, the cannula is inserted 3 mm below the gingival margin to attain virtually complete pocket penetration of irrigant. Povidone-iodine solution should be retained in subgingival sites for at least 5 min by repeated application or using retraction cords. This may reduce the total number of cultivable bacteria in untreated periodontitis lesions by 98%.[91]

Air Polishing

Air polishing devices have proven themselves to be safe and effective in the removal of subgingival oral biofilm in moderate to deep periodontal pockets without compromising the host's tissues as well as around the implants. They cause a shift in the microbiota with an increase in beneficial species and a decrease in pathogenic microbiota. Abrasion is the mechanism of action by which air polishing powders remove biofilm. Air polishing that incorporates slurry made up of air, water and sodium bicarbonate in a commercial device can help disrupt the sub gingival microbiota. In untreated periodontitis lesions with probing depths of 5-7 mm supragingival air polishing directed at 90^{o} angle to each tooth surface for 10 seconds has been shown to significantly reduce the mean proportion of sub gingival cultivable pathogenic bacteria (from 26% to 5%) and motile morphotypes (from 13% to 2%) to the total bacterial count (Rams and Slots 1994).[92]

Mouth Rinsing– Chlorhexidine is recognized as the gold standard against which other antiplaque and gingivitis agents are measured. Chlorhexidine antiplaque effect is a result of the dicationic nature of the chlorhexidine molecule, which affords the agent the property of persistence of antimicrobial effect at the tooth surface, through both bactericidal and bacteriostatic effects. Chlorhexidine rising 10-15 ml of 0.12 to 0.2% solutions for 30 seconds twice daily is recommended to reduce supragingival plaque and combat periodontal pathogens in the entire oropharyngeal cavity. However, the propensity of chlorhexidine to stain teeth and tooth coloured restorations may limit its use in some patients.

Systemic Antibiotic Therapy– Actively progressing periodontitis is virtually always associated with specific bacterial infections and often requires the adjunctive use of systemic antibiotic therapy. Systemic antibiotics enter the periodontal tissues and the periodontal pocket via serum and can affect organisms outside the reach of cleaning instruments or topical anti-infective chemotherapeutics. Systemic antibiotic therapy has also the potential to suppress periodontal pathogens residing on the tongue or other oral surfaces, thereby delaying subgingival recolonization of pathogens.[93] Early approach to systemic antibiotics in periodontal treatment included mainly single drug therapies with tetracyclines, penicillins, metronidazole or clindamycin. Since periodontitis lesions often harbour a mixture of pathogenic bacteria, drug combination therapies have gained increasing importance. Valuable combination therapies include metronidazole-amoxicillin (250-375 mg of each 3x daily for 8 days) for A. actinomycetemcomitans and various anaerobic periodontal infections, and metronidazole-ciprofloxacin (500 mg of each 2x daily for 8 days) for mixed anaerobic and enteric rod/pseudomonas periodontal infections.[93] Microbiological analysis is particularly advisable in periodontal lesions that are recalcitrant to conventional periodontal therapy and may harbour a great variety of periodontal pathogens. Employment of systemic antibiotics can give rise to a number of adverse reactions and should be administered only after proper patient evaluation.

Maintenance Care Appointments– The frequency of maintenance care appointments varies depending on patient's periodontal needs and possible financial constraints.

A number of practical methods of evaluating periodontal disease status present:

1. Periodontal Probing

It is not reasonable to wait until 3 mm of additional attachment loss has occurred before clinical intervention is initiated. Hence, clinicians must make treatment decisions before much additional damage has been developed. The exact set of clinical conditions that must be in place before additional treatment is rendered has not been established. Therefore, clinicians must be guided by the entire clinical picture and simple reliance on one clinical parameter will not suffice.

For example, if a patient on a supportive periodontal treatment program experiences a 1 mm increase in clinical attachment loss without any clinical signs of infection, it should alert the clinician that a possible problem exists. No special therapeutic intervention may be required, but the site should be carefully evaluated at the subsequent visit.

On the other hand, a 1 mm increase in clinical attachment loss at a site with heavy deposits of plaque and signs of infection most certainly would prompt the clinician to therapeutically intervene. This should be the approach even though a 1 mm change in clinical attachment loss may not be "real" since it is within the measurement error of manual probes.

Since a 2 mm increase in clinical attachment loss is within the reliable measurement range of probing, such a change has a high probability of being "real". In such situations a more aggressive therapeutic approach may be indicated, such as shortening the interval at which the patient is being seen for supportive periodontal treatment. However, the exact treatment rendered will depend on the entire set of clinical findings. No single clinical finding should be used as a standalone determinant for making treatment decisions.

Finally, it should be emphasized that in a supportive periodontal treatment program, clinical attachment levels are the best measurements to monitor the stability of the periodontal tissues.

2. Bleeding on Probing

Continuous absence of bleeding on probing is a useful indicator of periodontal health. Lang and colleagues (1996)[94] found that periodontal pockets exhibitory bleeding at 4 consecutive maintenance care visits had a 30% risk of losing attachment, whereas pockets exhibiting bleeding at 1 of 4 consecutive visits had as little as a 3% risk of experiencing breakdown.

3. Radiographic Examination of SPT Recall Patients

Patient condition	**Type of examination**
Patient with clinical caries or high risk factors for caries.	Posterior bitewing examination at 12 to 18 month intervals.
Patient with no clinical caries as high risk factors for caries.	Posterior bite wing examination at 24 to 36 month intervals.
Patients with periodontal disease not under good control.	Periapical and/or vertical bitewings of problem areas every 12 to 24 months full mouth series every 3 to 5 years.
Patients with history of periodontal treatment with disease under good control.	Bitewing examination every 24 to 36 months; full mouth series every 5 years.

Patients with root form dental implants.	Periapical or vertical bitewing at 6, 12 and 36 months after prosthetic placements, then every 36 months unless clinical problems arise.
Transfer periodontal or important maintenance patients.	Full mouth series if a current set is not available. If a full mouth series has been taken within 24 months, then radiographs of implants and periodontal problems areas should be taken.

Radiographically Evident Crestal Lamina Dura

The presence of radiographically evident crestal lamina dura is a valuable indicator of periodontal stability. Rams and Colleagues (1994)[58] found that sites with radiographically evident crestal lamina dura did not undergo breakdown for at least 2 years. However, the absence of lamina dura is not a specific indicator of progressive periodontitis, except perhaps for periodontal lesions exhibiting deep angular defects.

4. Microbiological Examination

Microbial analysis of the subgingival microbiota maybe indicated in some SPT patients who experience additional loss of periodontal attachment. In spite of proper SPT and patient compliance, progressive periodontal disease may reappear in some. This may be due to:

1. Rebound of periodontal pathogens from oral reservoirs.
2. Emergence of opportunistic pathogens.
3. Low host resistance.

Listgarten and Levin (1981)[95] found increased proportions of sub gingival spirochetes to predict subsequent periodontitis progression in treated adults receiving no or sporadic maintenance care. Listgarten et al. (1986)[45] detected no spirocheatal relationship with future breakdown in patients on regular maintenance.

Slots (1986)[96] incriminated actinobacillus actinomyces comitans as a major putative pathogen is refractory SPT lesions. In SPT patients Wennstrom et al (1987) detected additional breakdown after 12 months in 20% periodontal pockets harbouring actinobacillus actinomyces comitans, porphyromonas gingivalis or prevotella intermedia. However, the absence of these organisms was a better predictor of no further loss of periodontal attachment than the presence of these organisms was for disease progression.

Rams et al. (1996)[97] examined the predictive utility of 5 major putative periodontopathic species, super-infecting organisms, and several clinical parameters relative to periodontitis recurrence over a 12-month period. Treated adult patients (n=78) with a history of frequent periodontal breakdowns had been enrolled in a 3 months maintenance program for 2 years prior to the study. The investigation found a relative risk of 2.5 for periodontitis recurrence in subjects who at the start of the 12th month study, yielded cultivable subgingival proportions of either > 0.01% Actinobacillus actinomyces

comitans, > 0.1%, porphyromonas gingivalis, > 2.5% prevotella intermedia, > 2.0% campylobacter rectus or > 3.0% peptostreptococcus micros. The study may be the first one to show that selective subgingival microorganisms have a predictive value in some patients on SPT.

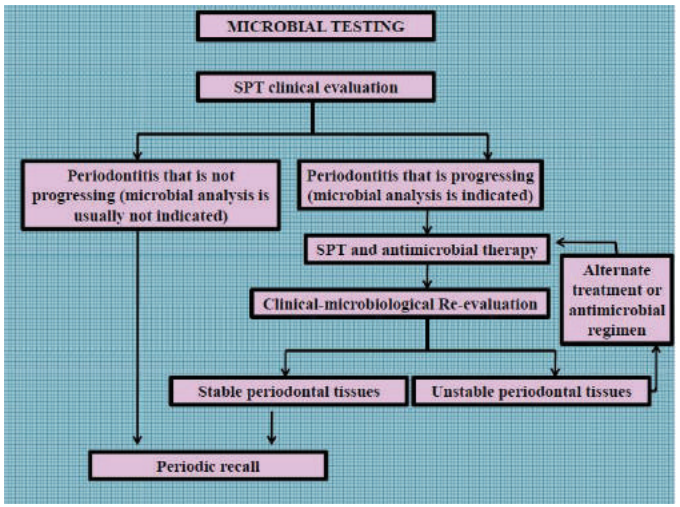

Fig. 3: Flow chart of microbiological testing in SPT patients

© Microbial analysis in supportive periodontal treatment, Jorgen Slots, Periodontology 2000. Vol. 12, 1996, 56-59

5. In Office Diagnostic Tests

The biological or immunological assessment of these biological fluids for specific mediators associated with the development of the periodontal lesion or provides the clinician with two important advantages:

1. Identification of the maintenance patient who is about to enter a period of disease progression. These patients should be removed from their SPT program so that additional treatment can be given.
2. Later, the effect of this therapy should be quantitatively assessed to determine whether the patient has re-entered a quiescent phase.

Available Commercial Tests Kits

1. Periogard– periodontal tissue monitor system. This chair side test kit is designed for estimating the aspartate amino transferase level in gingival crevicular fluid. AST is a soluble intracellular cytoplasmic enzyme that is released from within the cell upon its death. Since cell death is an important part of periodontal pathogenesis, AST levels in GCF have great potential as markers of early periodontal tissue destruction. Elevated total AST levels in a 30-second sample have been positively associated with disease-active sites in contrast to inactive sites.[98,99]

2. Pocketwatch periodontal tissue monitor system– This test kit has also been designed to estimate the aspartate amino transferase level in gingival crevicular fluid.[100] AST activity determined by pocket watch provides not only an index of cell death but of the extent of the destructive pockets.
3. Periocheck– This test kit is available for measuring the presence of non-specific neutral protease activity is gingival crevicular fluid. The test is only qualitative and not specific for PMNL collagenase, which is thought to be the dominant collagenase at active sites.[101] Indeed, a high proportion of the enzyme is likely to be bacterial in origin. Furthermore, interproximal sites cannot be sampled, due to the risk of saliva contamination, and this is clearly a major drawback with this method.
4. Prognostik– This test kit was released in the year 1993. This system detects the presence of serine proteinase elastase in GCF sample.[102]

Commercial Diagnostic Tests Kits Under Development

1. β-glucoronidase– A diagnostic kit based on β-glucoronidase is being commercially developed by Affot laboratories, North Chicago, USA.
2. Cysteine and serine proteinases– A test system suitable for chair side use has been developed by enzyme system products/prototek of public, CA, USA.

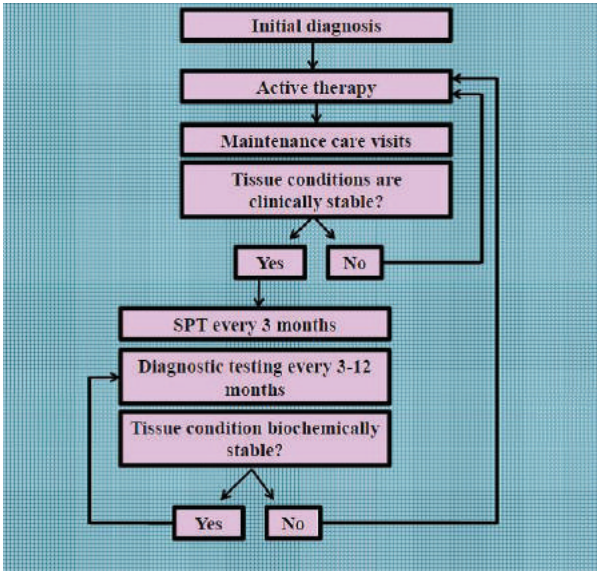

Fig.4: Proposed simple decision free for use of host response diagnostic test for periodontal disease

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Chapter 7

Patients Role in Supportive Periodontal Therapy

The least expensive way to manage periodontal disease is through self-care; however, the effectiveness of patients' preventive efforts is questionable. To improve self-care measures, dental professionals must communicate effectively with patients and reinforce the need for preventive periodontal therapy.

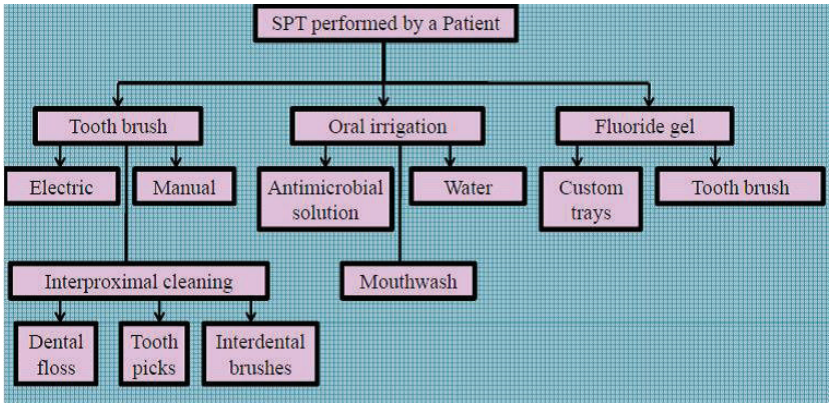

Fig. 5: Patients role in supportive periodontal therapy

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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 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.[103]

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.[104]

Anti-Plaque 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.[105-107] Daily tongue cleaning, via brushing or scraping, can help reduce potential pathogenic organisms residing on the dorsum of the tongue and subsequently in saliva,[108,109] but it may not reduce the quantity of plaque formed on the teeth.[110] 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.[107,111,112] 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.[113,114] 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% of patients use dental floss on a daily basis and more than 50% never use it.[115,116] Numerous devices are available to facilitate manipulation of dental floss,[117] which may improve compliance in some patients.[118,119] For all anti-plaque measures, it is important to remember that overzealous and improper use of the toothbrush or dental floss can damage the teeth and the periodontium.

Irrigation

In patients will increased pocket depths that harbours numerous pathogens, special efforts must be made to control the sub gingival microbiota. Cobb and colleagues[120] 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% of the depth of periodontal pockets that are 6 mm or less, and to a depth of 64% of the depth of pockets that are 7 mm or more.[121] Subgingival irrigation can significantly decrease the number of P. intermedia[122] and other bacteria[120] 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, NaCIO, metronidazole and magnetized water.[123-132] 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% chlorhexidine mouthrinse used twice daily for one to two weeks is a valuable aid in whole mouth disinfection. NaCIO solution. Lobene and colleagues[127] found that irrigation with diluted (0.5%) NaCIO solution caused significantly greater and long-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% NaCIO solution more agreeable.

Supra-gingival irrigation: is usually performed once or twice daily in adjunct to tooth brushing and flossing. The irrigators nozzle should be positioned at some distance from the gingival margin and the jet stream lined perpendicular to the long axis of the teeth. Pressures of 540 KPa to 620 Kpa can be tolerated without adverse effects.

Subgingival irrigation: To penetrate the periodontal pocket near its base by 75% to 93% rubber tip nozzles all positioned at the gingival margin or blunted cannulas are inserted into the periodontal pocket. Ejection pressures range from 0.7 Kpa to 35 KPa. Adjunctive subgingival irrigation has a substantial long-term benefit beyond its use in scaling and root planing.

Irrigants showing benefits as adjuncts to periodontal therapy

	Conc. (%)	Amount (ml)	Application per day
Water	NA	500	1
CHX	0.06	200	1
SaF_2	0.02	500	1
Listerine	Undiluted	100	1
Iodine	0.38	200	1

It is well established that the use of electric toothbrushes has a particular advantages in controlling plaque accumulation in patients with low compliance to oral hygiene.

Hellstadius et al reported on a group of patients with low compliance that had been referred for specialist periodontal treatment. These patients had previously received extensive oral hygiene instruction with manual aids, over a period extending upto 40 months and still there remained less than acceptable plaque control with plaque scores of 40%, substitution of their manual toothbrush with electric tooth brushes reduced their mean plaque score to 12%. This was maintained for the period of observation upto 3 years.

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Chapter 8

Periodontal Risk Assessment (PRA) for Patients in Supportive Periodontal Therapy (SPT)

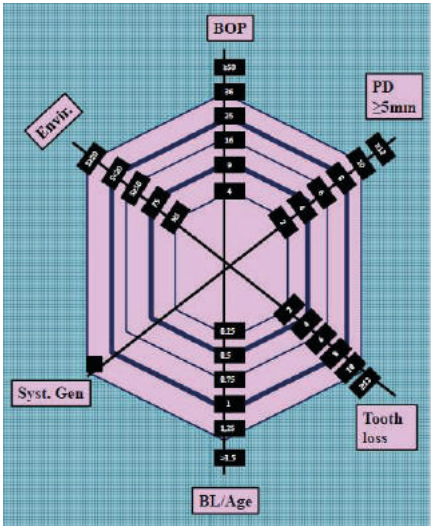
Under proper regular maintenance the patient can maintain stable clinical attachment levels for many years. Hence, it is necessary to determine the clinical parameters which may serve as early indicators for a new onset or recurrence of the periodontal disease process. As opposed to the general population without such a history, periodontal patients need to participate in a well-organized recall system which should provide both a continuous risk assessment and adequate supportive care. Without this, the patients are likely to experience progressive loss of periodontal attachment.[3,4,7,133] The assessment of the risk level for disease progression in each individual patient would enable the practitioner to determine the frequency and extent of professional support necessary to maintain the attachment levels obtained following active therapy. The determination of such risk levels would thus prevent both under treatment, and excessive over treatment, during SPT.[134]

Subject Risk Assessment

The patient's risk assessment for recurrence of periodontitis may be evaluated on the basis of a number of clinical conditions whereby no single parameter displays a more paramount role. The entire spectrum of risk factors and risk indicators ought to be evaluated simultaneously.

For this purpose, a functional diagram has been constructed (Fig. 6) including the following aspects:

1. Percentage of bleeding on probing.
2. Prevalence of residual pockets greater than 5 mm.
3. Loss of teeth from a total of 28 teeth.
4. Loss of periodontal support in relation to the patient's age.
5. Systemic and genetic conditions, and
6. Environmental factors, such as cigarette smoking.



(Fig. 6: Functional diagram to evaluate the patient's risk for recurrence of periodontitis. Each vector represents one risk factor or indicator with an area of relatively low risk, an area of moderate risk and an area of high risk for disease progression. All factors have to be evaluated together and hence, the area of relatively low risk is found within the centre circle of the polygon, while the area of high risk is found outside the periphery of the second ring in bold. Between the two rings in bold, there is the area of moderate risk.)

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Each parameter has its own scale for minor, moderate and high-risk profiles. A comprehensive evaluation of the functional diagram will provide an individualized total risk profile and determine the frequency and complexity of SPT visits. Modifications may be made to the functional diagram if additional factors become important according to new evidence.

Percentage of sites with bleeding on probing (BOP): Bleeding on probing represents an objective inflammatory parameter. It has been incorporated into index systems for the evaluation of periodontal conditions[135,136] and is also used as a parameter by itself. Although there is no established acceptable level of the prevalence of bleeding on probing in the dentition above which a higher risk for disease recurrence has been established, a BOP prevalence of 25% has been the cut-off point between patients who maintained periodontal stability for 4 years and patients with recurrent disease in the same time frame in a prospective study in a private practice.[137] Further evidence of BOP percentages between 20 and 30% determining a higher risk for disease progression originates from studies of Claffey et al.[138] and Badersten et al.[139] In assessing the patient's risk for disease progression, BOP percentages reflect a summary of the patient's ability to perform proper plaque control, the patient's host response to the bacterial challenge and the patient's compliance, especially when only

few residual pockets remain after active periodontal therapy. The percentage of BOP, therefore, is used as the first risk factor in the functional diagram of risk assessment (Fig.1). The scale runs in a quadratic mode with 4, 9, 16, 25, 36 and > 49% being the critical values on the vector. Individuals with low mean BOP percentages (< 10% of the surfaces) may be regarded as patients with a low risk for recurrent disease, while patients with mean BOP percentages > 25% should be considered to be at high risk for periodontal breakdown.

Prevalence of residual pockets ≥ 5 mm

The enumeration of the residual pockets with probing depths greater than 4 mm represents - to a certain extent - the degree of success of periodontal treatment rendered. When considered as a sole parameter, the evaluation in conjunction with other parameters such as bleeding on probing and/or suppuration will reflect existing ecological niches from and in which re-infection might occur. It is, therefore, conceivable that periodontal stability in a dentition would be reflected in a minimal number of residual pockets. Presence of high frequencies of deep residual pockets and deepening of pockets during supportive periodontal care has, in fact, been associated with high risk for disease progression.[138,139] In assessing the patient's risk for disease progression, the number of residual pockets with a probing depth of ≥ 5 mm is assessed as the second risk indicator for recurrent disease in the functional diagram of risk assessment (Fig. 1). The scale runs in a linear mode with 2, 4, 6, 8, 10 and ≥ 12% being the critical values on the vector. Individuals with up to 4 residual pockets may be regarded as patients with a relatively low risk, while patients with more than 8 residual pockets as individuals with high risk for recurrent disease.

Loss of teeth from a total of 28 teeth

Even though the reason for tooth loss may not be known, the number of remaining teeth in a dentition reflects the functionality of the dentition. Mandibular stability and individual optimal function may be assured even with a shortened dental arch of premolar to premolar occlusion, i.e. 20 teeth. The shortened dental arch does not seem to predispose the individual to mandibular dysfunction.[140,141] However, if more than 8 teeth from a total of 28 teeth are lost, oral function is usually impaired.[142-144] Since tooth loss also represents a true end point outcome variable reflecting the patient's history of oral diseases and trauma, it is logical to incorporate this risk indicator as the third parameter in the functional diagram of risk assessment (Fig. 1). The number of teeth lost from the dentition without the third molars (28 teeth) is counted, irrespective of their replacement. The scale runs also in a linear mode with 2, 4, 6, 8, 10 and 12 being the critical values on the vector. Individuals with up to 4 teeth lost may be regarded as patients in a low risk category, while patients with more than 8 teeth lost may be considered as being in a high-risk category. Rationale for this stems from the significance of further tooth loss in terms of preservation of the function of the dentition.

Loss of periodontal support in relation to the patient's age

The extent and prevalence of periodontal attachment loss (i.e. previous disease experience and susceptibility), as evaluated by the height of the alveolar bone on radiographs, may represent the most obvious indicator of subject risk when related to the patient's age. In light of the present understanding of periodontal disease progression, and the evidence that both onset and rate of progression of periodontitis might vary among individuals and during different time frames,[145] it has to be realized that previous attachment loss in relation to the patient's age does not rule out the possibility of rapidly progressing lesions. Therefore, the actual risk for further disease progression in a given individual may occasionally be underestimated. Hopefully, the rate of progression of disease has been positively affected by the treatment rendered and, hence, previous attachment loss in relation to patient's age may be a more accurate indicator during SPT than before active periodontal treatment. Given the hypothesis that a dentition may be functional for the most likely life expectancy of the subject in the presence of a reduced height of periodontal support (i.e. 25-50% of the root length), the risk assessment in treated periodontal patients may represent a reliable prognostic indicator for the stability of the overall treatment goal of keeping a functional dentition for a lifetime.[146]

The estimation of the loss of alveolar bone is performed in the posterior region on either periapical radiographs, in which the worst site affected is grossly estimated in percent of the root length or on bitewing radiographs in which the worst site affected is estimated in millimetre. On bitewing radiographs, one millimetre is considered to be equal to 10% bone loss. The percentage is then divided by the patient's age. This results in a factor. As an example, a 40 years old patient with 20% of bone loss at the worst affected posterior site would score BL/Age = 0.5. Another 40 years old patient with 50% bone loss at the worst affected posterior site would score BL/Age = 1.25. In assessing the patient's risk for disease progression, the extent of alveolar bone loss in relation to the patient's age is estimated as the fourth risk indicator for recurrent disease in the functional diagram of risk assessment (Fig. 1). The scale runs in increments of 0.25 of the factor BL/Age, with 0.5 being the critical value to discriminate between low and moderate risk and 1.0 being the value for moderate and high risk. This, in turn, means that a patient who has lost a higher percentage of posterior alveolar bone than his/her own age is at high risk regarding this vector in a multi-factorial assessment of risk. It may be argued that the incorporation of only the worst site with bone loss in the posterior segment may overestimate an individual's rate of periodontal destruction when only an isolated advanced bony lesion is present due to local etiologic factors, while an underestimation of the rate of destruction may exist in a case of generalized advanced disease. In patients successfully treated for periodontitis it has recently been demonstrated that the worst site with bone loss in the posterior segment may, indeed, represent the past history of destruction of the entire dentition.[147]

Systemic and genetic aspects

The most substantiated evidence for modification of disease susceptibility and/or progression of periodontal disease arises from studies on Type I and Type II (insulin-dependent and non-insulin-dependent) diabetes mellitus populations.[148-150] It has to be realized that the impact of diabetes on periodontal diseases has been documented in patients with untreated periodontal disease, while, as of today, no clear evidence is available for treated patients. It is reasonable, however, to assume that the influence of the systemic conditions may also affect recurrence of disease. In recent years, genetic markers have become available to determine various genotypes of patients regarding their susceptibility to periodontal diseases. Research on the Interleukin-1 (IL-1) polymorphisms has indicated that IL-1 genotype positive patients show more advanced periodontitis lesions than IL-1 genotype negative patients of the same age group.[151] Also, there is a trend to higher tooth loss in the IL-1 genotype positive subjects.[152] In a retrospective analysis of over 300 well maintained periodontal patients, the IL-1 genotype positive patients showed significantly higher BOP percentages and a higher proportion of patients which yielded higher BOP % during a one-year recall period than the IL-1 genotype negative control patients.[153] Also, the latter group had double as many patients with improved BOP % during the same maintenance period indicating that IL-1 genotype positive subjects, indeed, represent a group of hyper reactive subjects even if they are regularly maintained by normally effective SPT.[153] In a prospective study over 5 years on Australian white and blue collar workers at a university campus, the IL-1 genotype positive age group above 50 years showed significantly deeper probing depths than their IL-1 genotype negative counterparts, especially when they were non-smokers.[154] In assessing the patient's risk for disease progression, systemic factors, if known, are only considered as the fifth risk indicator for recurrent disease in the functional diagram of risk assessment (Fig. 1). In this case, the area of high risk is marked for this vector. If not known or absent, systemic factors are not taken into account for the overall evaluation of risk. Research on the association and/or modifying influence in susceptibility and progression of periodontitis of physical or psychological stress is sparse.[155,156] The hormonal changes associated with this condition, however, are well documented.[157]

Cigarette smoking

Consumption of tobacco, predominantly in the form of smoking rather than snuffing or chewing, affects the susceptibility and the treatment outcome of patients with chronic periodontitis. Classical explanations for these observations have included the association between smoking habits and poor oral hygiene as well as unawareness of general health issues.[158,159] More recent evidence, however, has established that smoking per se represents not only a risk marker, but also probably a true risk factor for periodontitis.[160-162] In a young population (19-30 years of age), 51-56% of periodontitis

was associated with cigarette smoking.[162] The association of smoking and periodontitis has been shown to be dose-dependent.[162]

It has also been shown that smoking will affect the treatment outcome after scaling and root planing,[163] modified Widman flap surgery,[164] and regenerative periodontal therapy.[165] Furthermore, a high proportion of so called refractory patients have been identified as consisting of smokers.[166] The impact of cigarette smoking on the long-term effects of periodontal therapy in a population undergoing supportive periodontal care has been recently reported. Smokers displayed less favourable healing responses both at re-evaluation and during a 6-year period of SPT.[167] In spite of the paucity of evidence relating cigarette smoking to impaired outcomes during supportive periodontal care, it seems reasonable to incorporate heavy smokers (20 cigarettes/day) in a higher risk group during maintenance.

In assessing the patient's risk for disease progression, environmental factors such as smoking must be considered as the sixth risk factor for recurrent disease in the functional diagram of risk assessment (Fig. 1). While non-smokers (NS) and former smokers (FS; more than 5 years since cessation) have a relatively low risk for recurrence of periodontitis, the heavy smokers (HS; as defined by smoking more than one pack per day) are definitely at high risk. Occasional smokers (OS; < 10 cigarettes a day) and moderate smokers (MS; 10-19 cigarettes a day) may be considered at moderate risk for disease progression.

Calculating the Patient's Individual Periodontal Risk Assessment (PRA)

Based on the six parameters specified above, a multi-functional diagram is constructed for the PRA. In this diagram, the vectors have been formed on the basis of the scientific evidence available. It is obvious that ongoing validation may result in slight modifications. A low PRA patient has all parameters within the low risk categories or at the most one parameter in the moderate risk category. (Fig. 7)

A moderate PRA patient has at least two parameters in the moderate category, but at most one parameter in the high-risk category. (Fig. 8)

A high PRA patient has at least two parameters in the high-risk category. (Fig. 9)

In a high-risk patient who yields high BOP percentages and high numbers of residual pockets, (Fig. 10) the patient's risk for disease progression may be reduced into the moderate category if further periodontal therapy is provided. These two parameters (BOP and residual pockets) are easily affected by therapy, while other parameters, such as numbers of missing teeth or systemic and genetic factors are either irreversible and cannot be reduced or may only be affected with great additional efforts (smoking cessation). The factor determining the percentage of experienced alveolar bone loss in relation to the patient's age may be reduced only during a time period of several years.

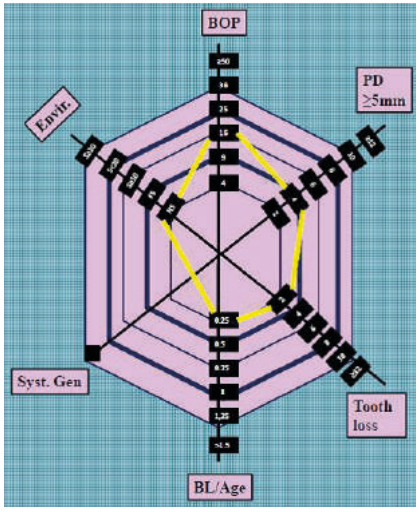

Fig. 7: Functional diagram of a low-risk maintenance patient. BOP is 15%, 4 residual pockets ≥5 mm are diagnosed, 2 teeth had been lost, the bone factor in relation to the age is 0.25, no systemic factor is known and the patient is a non-smoker.

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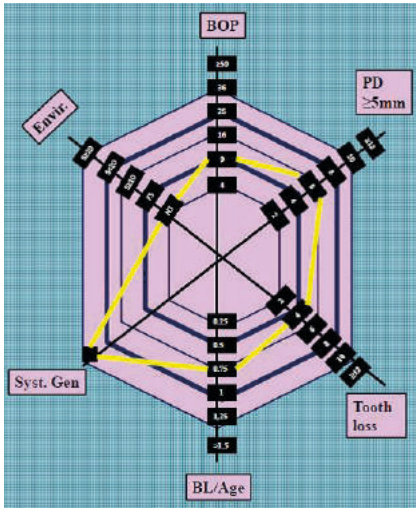

Fig. 8: Functional diagram of a medium-risk maintenance patient. BOP is 9%, 6 residual pockets 5 mm are diagnosed, 4 teeth had been lost, the bone factor in relation to the age is 0.75,the patient is a Type I diabetic, but a non-smoker.

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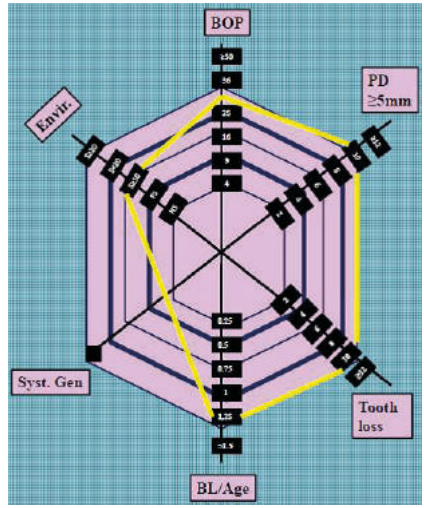

Fig. 9: Functional diagram of a high-risk maintenance patient. BOP is 32%, 10 residual pockets 5 mm are diagnosed, 10 teeth had been lost, the bone factor in relation to the age is 1.25, no systemic factor is known and the patient is an occasional smoker.

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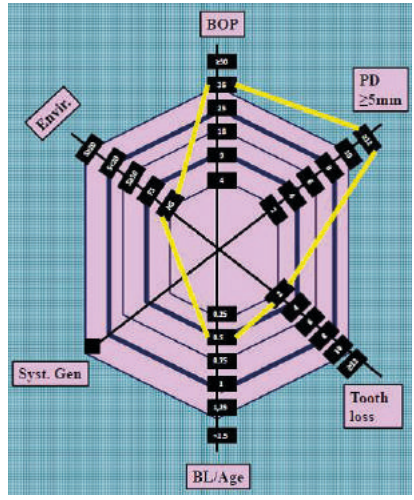

Fig. 10: Functional diagram of another high-risk maintenance patient. BOP is close to 50%, more than 12 residual pockets 5 mm are diagnosed, but only 2 teeth had been lost. The bone factor in relation to the age is 0.5, no systemic factor is known and the patient is a non-smoker. Additional periodontal therapy may change this patient's risk into the moderate or even low-risk category since BOP and residual pockets would be affected.

© Fig 10 Lang NP, Tonetti MS. Periodontal risk assessment (PRA) for patients in supportive periodontal therapy (SPT). Oral Health Prev Dent. 2003 Jan 1;1(1):7-16.

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Chapter 9

Role of Periodontist During SPT

The recall hour should be planned to meet the patient's individual needs. The time required for a recall visit for patients with multiple teeth in both arches is approximately 1 hour comprising of three parts. The first part is concerned with examination and re-evaluation of the patient's current oral health. The second part includes the necessary motivation, re-instructions and maintenance treatment. The third part involves scheduling the patient for the next recall appointment, additional periodontal treatment (polishing), or restorative dental procedures (fluoride application).

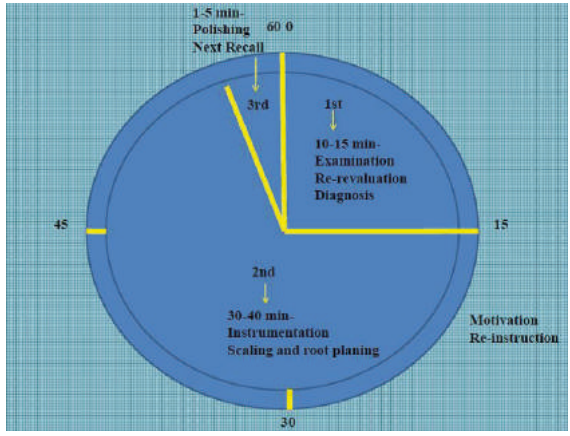

Fig. 11: (Maintenance program SPT recall hours divided into three parts)
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First Part (Approx. 10-15 Min)

Examination: Periodontal examination includes an evaluation of the probing depths, bleeding on probing, mobility, the health of the gingival tissues, amount of additional recession, furcation involvement and incidence of suppuration. Determining the percentage of sites with bleeding on probing can be helpful and repeated site-specific bleeding on probing may indicate an individual area of periodontal breakdown. Any desired microbial monitoring can be accomplished at this stage of the appointment. The therapist is continually re-evaluating the success of the periodontal therapy and determining future maintenance procedures with the assessment of these clinical parameters.

Radiographs: Periodic vertical bitewing radiographs are taken to monitor for any radiographic bone loss or caries; these radiographs are compared with previous radiographs. During maintenance therapy, a full mouth series of radiographs may be beneficial approximately every 5 years to be able to accomplish a complete radiographic evaluation. If general periodontal deterioration is noted from the clinical parameters, then radiographs can be ordered at any appointment. Conversely, if the patient maintains excellent periodontal stability, a full-mouth series of radiographs may not be needed every 5 years.

A plaque assessment using disclosing solution can indicate areas that the patient consistently misses in their daily hygiene regimen and may indicate a needed change in patient hygiene techniques or instrumentation.

Second Part (Approx. 30-40 Min)

Patients frequently need reinforcement of instructions and motivation to continue diligent oral hygiene. An overall increase in gingival inflammation with a generalized increase in the bleeding index may indicate continual poor patient oral hygiene efficiency. A significant increase in the bleeding index with an acceptable plaque index at the maintenance appointment may indicate that the patient had performed adequate oral hygiene for only a few days before the appointment. Debridement procedures including scaling, root planing, and polishing vary depending on the clinical parameters and any presence of deteriorating sites. If significant deposits of subgingival calculus are detected, this may indicate a need for nonsurgical retreatment of selected areas. If multiple sites are found to need additional scaling and root planing, the patient may need to be reappointed for additional treatment because the actual time for debridement during a maintenance visit is limited. In some instances, a locally delivered antimicrobial agent may be indicated. Topical fluoride treatment for caries prevention is often indicated. Caries and restoration assessments are accomplished at every appointment because exposed root surfaces resulting from periodontal disease can be at risk for root caries.

Third Part (Approx. 1-5 Min)

Scheduling the patient for the next recall must be based on the patient's risk assessment. Polishing the entire dentition to remove all remaining soft deposits and stains provides freshness to the patient and facilitates the diagnosis of early carious lesions. Following polishing, fluorides should be applied in high concentration in order to replace the fluorides which might have been removed by instrumentation from the superficial layers of the teeth. Fluoride or chlorhexidine varnishes may also be applied to prevent root surface caries, especially in areas with gingival recession.

Supportive Periodontal Therapy in Daily Practice

The recall hour should be planned to meet the patients' individual needs. It consists of 4 different sections:

1. Examinations, re-evaluation and diagnosis (ERD).

2. Motivation, re-instruction and instrumentation (MRI)
3. Treatment of re-infected sites (TRS).
4. Polishing of the entire dentition, application of fluorides and determination of future SPT (PFD).

1. Examination, Re-evaluation and Diagnosis (ERD)

Since patients on SPT may experience significant changes in their health status and the use of medications, an update of the information on general health is appropriate. Changes in the health status and medications must be noted.

After assessment of the subjects' risk factors, the tooth site– related risk factors are evaluated. The diagnostic procedure usually includes the following:

1. Oral hygiene and plaque situations
2. The determination of sites with bleeding on probing, indicating persistent inflammation.
3. Scoring pocket probing depth and clinical attachment level.
4. Inspection of re-infected sites with pus formation.
5. Evaluation of existing reconstructions, including vitality checks for abutment teeth.
6. Exploration for carious lesions.

Occasionally, conventional dental radiographs are obtained.

2. Motivation, Reconstructions and Instrumentation (MRI)

When informed about the results of the diagnostic procedures, the patient may be motivated either in a confirmatory way in case of low scores (bleeding and plaque) or in a challenging fashion in case of high scores, since encouragement usually has a greater impact on future positive developments than negative criticism, every effort should be made to acknowledge the patients performance.

Patients who have experienced a relapse in their adequate oral hygiene practices need to be further motivated; "standard lecturing" should be replaced by an individual approach.

Occasionally, when patients present with hard tissue lesions, which suggests overzealous or faulty mechanical tooth cleaning, they should be instructed in tooth brushing technique that emphasize vibratory rather than scrubbing movements.

Only those sites will be re-instrumented during SPT visits which exhibit signs of inflammation and/or active disease progression. Regression analysis of several longitudinal studies such as Lindhe et al. (1982)[52] have shown that probing attachment may be lost following instrumentation of pockets below a "critical probing depth" of approximately 2.9 mm, the deliberate removal of "contaminated" cementum is no longer justified.[168-170] Especially during SPT visits, root surface instrumentation should be aimed at the removal of sub gingival plaque rather than "diseased" cementum.

3. Treatment of Re-infected Sites (TRS)

Single sites, especially furcation sites or sites with difficult access, may occasionally be re-infected and demonstrate suppuration. Such sites require a through instrumentation under anaesthesia, the local application of antibiotics with control release devices or even open debridement with surgical access. It is evident that such therapeutic measures may be too time consuming to be performed during the routine recall hour, and hence, it may be necessary to reschedule the patient for on other appointment. Omission of thoroughly re-treating such sites or only performing incomplete root planning during SPT may result in continued loss of probing attachment. Generalized re-infections are usually the result of inadequate SPT. High bleeding on probing percentages call for more intensive care and frequent SPT visits. Local re-infections may be either be the result of inadequate plaque control in a local area or the formation of ecological niches conducive to periodontal pathogens.

4. Polishing Fluorides, Determination of Recall Interval (PFD)

The recall hour is concluded with polishing the entire dentition to remove all remaining soft deposits and stains. Following which fluorides should be applied in high concentration in order to replace the fluorides, which have been removed by instrumentation from superficial layer of the teeth. The determination of future SPT visits must be based on the patients risk assessment.

Supportive Periodontal Therapy for Patients with Gingivitis

Several studies,[3,110] predominantly in children, have documented that periodic professional prophylactic visits in conjunction with reinforcement of personal oral hygiene are effective in controlling gingivitis. This, however, does not imply that maintenance visits in childhood preclude the development of more severe disease later in life. It is obvious that SPT, therefore, must be a lifelong commitment of both the patient and the profession.

Adults whose effective oral hygiene was combined with periodic professional prophylaxis were clearly healthier periodontally than patients who did not participate in such programs.[32,57] One particular study of historic significance was performed on 1428 adults from an industrial company in Oslo, Norway (Lövdal et al.(1961)[32] Over a 5-year observation period, the subjects were recalled two to four times per year for instruction in oral hygiene and supragingival and subgingival scaling. Gingival conditions improved by approximately 60% and tooth loss was reduced by about 50% of what would be expected without these efforts. When adult patients with gingivitis were treated with scaling and root planing, but did not improve their oral hygiene procedures, the gingival condition did not improve compared with individuals receiving prophylaxes at 6-month intervals.

In a study done by Suomi et al. (1971)[57] loss of periodontal tissue support in young individuals with gingivitis or only loss of small amounts of attachment was followed over 3 years. An experimental group receiving scaling and instructions in oral hygiene every 3 months yielded significantly lost plaque and gingival inflammation than the control group where no special efforts had been made. The mean loss of probing attachment was only 0.08 mm per surface in the experimental as opposed to 0.3 mm in the control group.

When adult patients with gingivitis were treated with scaling and root planing, but did not improve their oral hygiene procedures, the gingival condition did not improve compared with individuals receiving prophylaxes at 6-month intervals (Listgarten and Schifter 1982).

Ramfjord et al. (1982) reviewed oral hygiene and maintenance of periodontal support. 78 patients were treated and maintained with 3-month recalls over a period of 8 years. Variations in probing depth and attachment levels were related to individuals with plaque scores above and below the median. Results indicated personal oral hygiene, based on plaque scores, was not critical for maintenance of post-treatment probing depth and attachment levels in patients receiving professional tooth cleaning every 3-month over the 8 years. After 1 year, there was no indication that individuals with poor oral hygiene had any greater loss of attachment than those with good oral hygiene.

In a companion paper, Morrison et al. (1982) reported on 78 patients in a 7-year longitudinal study which compared the effect of gingivitis on the maintenance of probing depth reduction and clinical attachment levels. For probing depths 1 to 3 mm and 4 to 6 mm there was no difference in pocket reduction maintenance. There was no difference in attachment response in 1 to 3 mm probing depths, and in 4 to 6 mm PD, lower gingivitis scores had better gain the first 2 years, but thereafter no difference was recorded. For 7 to 12 mm PD, 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 study.

Thus the prevention of gingival inflammation and early loss of attachment in patients with gingivitis depends primarily on the level of personal plaque control, but also on further measures to reduce the accumulation of supragingival and subgingival plaque.

P. Axelsson and J. Lindhe in (1981)[3] had done a study to assess the efficacy of a maintenance care program to prevent recurrence of disease in patients subjected to treatment of advanced periodontitis. In addition, the periodontal status was monitored of a group of patients who following the end of active treatment were referred back to general practitioners for maintenance care. The material consisted of 90 patients who in 1972 were referred for specialist treatment of advanced periodontal disease. The patients were first subjected to an initial examination including assessment of oral hygiene, gingivitis, probing depths and attachment levels. They were instructed how to practice proper tooth cleaning methods, their teeth were scaled and eventually the periodontal pockets were treated using the modified Widman technique. During

the first 2 months following surgery the patients were recalled once every 2 weeks for professional tooth cleaning. Two months after the end of surgical treatment, the patients were re-examined to provide baseline data. Every third patient was thereafter referred back to the general dentist for maintenance care. Two out of three patients were maintained in a carefully designed and controlled maintenance care program at the university clinic. This program involved recalls once every 2-3 months and included instructions and practice in oral hygiene, meticulous scaling and professional tooth cleaning. The patients were re-examined 3 and 6 years after the baseline examination. The results demonstrated that in patients suffering from destructive periodontitis, a treatment program that involved oral hygiene instruction, scaling, root planing and modified Widman flap procedures resulted in the establishment of clinically healthy gingiva and shallow pockets. Patients who were placed on a carefully designed recall program were over a 6 years period able to maintain excellent oral hygiene standards and unaltered attachment levels. In contrast patients who subsequent to active treatment were not maintained in a supervised program showed obvious signs of recurrent periodontitis at the follow-up examinations.

Supportive Periodontal Therapy for Patients with Periodontitis

A series of longitudinal studies on periodontal therapeutic modalities was performed over the past 25 years. These studies always incorporated the patients into a well-organized maintenance care system with recall visits at regular intervals (generally 3-4 months). Although the patients performed plaque control with various degrees of efficacy, the SPT resulted in excellent maintenance of post-operative attachment levels in most patients (Ramfjord et al. 1982).[47] On average, excellent treatment results with maintained reduced probing depths and maintained gains of probing attachment were documented for most of the patients in the longitudinal studies irrespective of the treatment modality chosen.

In a study on 75 patients with extremely advanced periodontitis, who had been successfully treated for the disease, a result of cause-related therapy and modified Widman procedures Lindhe and Nyman (1984),[22] recurrent infections occurred in only very few sites during a 14 years period of effective SPT. However, it has to be realized that recurrent periodontitis was noticed at completely unpredictable time intervals but was concentrated in about 25% of the patient population (15 out of 61). This suggests that, in a periodontitis-susceptible risk population, the majority of patients can be "cured" provided an optimally organized SPT is performed, while a relatively small proportion of patients (20-25%) will suffer from occasional episodes of recurrent periodontal re-infection. It is obviously a challenge for the diagnostician to identify such patients with very high disease susceptibility and to monitor the dentitions for recurrent periodontitis on a long-term basis.

As opposed to the study by Lindhe and Nyman[22] which involved exclusively patients will advanced periodontitis, another study on 52 patients with generalized mild

to moderate adult periodontitis addressed the efficacy 8 years following completion of cause– related periodontal therapy (Bragger et al. 1992).[134] Full mouth intra-oral radiographs were used to assess changes in alveolar bone height as a percentage of the total root length. As a result of cause related therapy, a gain in probing attachment followed by a loss of 0.5-0.8 mm over the following 8 years period was observed. The radiographic loss of alveolar bone height in the same time period was < 2%, though clinically insignificant. In this patient group initially presenting with mild to moderate periodontitis, the frequency of SPT rendered per year did not affect the rate of progression of periodontal disease. However, patients seeking SPT less than once per year over 8 years lost further periodontal attachment during the period of observation.

From these studies, it is evident that patients having experienced periodontitis need some kind of SPT. The frequency of SPT visits has to be adapted to the risk of susceptibility for the disease. Patients with advanced periodontitis may need SPT at a regular and rather short time intervals (3-4 months), while for mild to moderate forms of periodontitis, one annual visit may be enough to prevent further loss of attachment.

The effect of a plaque control based maintenance program on tooth mortality, caries, and periodontal disease progression was presented after 30 years of SPT in a private dental office (Axelsson et al. 2004). This prospective controlled cohort study initially included 375 test and 180 control patients that received traditional maintenance care (by the referring dentist once to twice a year). After 6 years, the control group was discontinued. The test group was subjected to prophylactic visits every second month for the first 2 years and every 3-12 months (according to their individual needs) during years 3-30. The prophylactic visits to the dental hygienist included plaque disclosure and professional mechanical tooth cleaning, including the use of a fluoride containing dentifrice. During the 30 years of maintenance, very few teeth were lost (0.4-1.8%), and these were predominately lost because of root fractures. Within 30 years of maintenance, 1.2-2.1 new carious lesions (> 80% secondary caries) were found. With the exception of buccal sites, no sites demonstrated any loss of periodontal attachment during this period. On approximal sites, there was even some gain of attachment. This unique study clearly demonstrated that SPT based on plaque control tailored to the individual needs of the patient will result in very low tooth mortality, minimal recurrent caries, and almost complete periodontal stability.

Furcation-involved molars respond less favourably to periodontal therapy than molars without furcation involvement or single-rooted teeth and are at a greater risk for further attachment loss compared with other teeth.[60]

This problem was also described by Kalkwarf et al. (1988),[150] who reported the success of different surgical and non-surgical treatment modalities on 158 molars. During the 2-year observation period, the horizontal defect in the furcation area increased independently of the therapy performed.[150]

Numerous factors contribute to a more severe disease progression in furcation-involved molars, recurrent periodontal infection, and as a result an inferior long-

term prognosis of these teeth.[151] These factors include morphological features such as enamel projections and accessory pulpal canals into the furcation, anatomy that impedes accessibility for individual oral hygiene in the molar region, and professional root debridement.[103]

Hirschfeld and Wasserman (1978)[54] examined retrospectively the periodontal conditions of 600 patients who had been previously treated for 15-55 years. Over the 22-year average period of maintenance, 7.1% of all teeth were lost due to periodontal causes. The tooth loss rate of those teeth with furcation involvement was much higher (31%).[54] Similar results were reported by McFall (1982),[152] who observed an overall tooth loss of 10% of all teeth and 57% of teeth with probable furcation involvement over a maintenance period of 19 years.[152]

Topical subgingival application of antibiotics may improve the results of non-surgical periodontal treatment. This has been observed after use of a 14% doxycycline gel in untreated active periodontal therapy (APT) (Eickholz et al. 2002)[153] and SPT patients (Lang et al. 2005).[154] Further, for SPT patients, subgingival application of this doxycycline gel showed clinical results at least as good as scaling and root planing (SRP) (Eickholz et al. 2005).[155]

Supportive Periodontal Therapy for Patients with Implant

According to the glossary of prosthodontics terms an implant is defined as "any object or material, such as an alloplastic substance or other tissue, which is partially or completely inserted and grafted onto the body for the diagnostic, prosthetic and experimental purpose."[171]

Osseointegration (a term originally proposed by Branemark et al. 1969)[172] was provided by Albrektsson et al. (1981)[173] who suggested that this was "a direct functional and structural connection between living bone and the surface of a load carrying implant". Another, clinical definition was provided by Zarb and Albrektsson (1991)[174] who proposed that osseointegration was "a process whereby clinically asymptomatic rigid fixation of alloplastic materials is achieved and maintained in bone during functional loading".

The integration of hard and soft tissues with implants is the result of a wound healing process. The healing events in the mucosal compartment include the formation of a barrier epithelium adjacent to the implant and, apical to this epithelium, a connective tissue that integrates with the titanium surface and thereby prevents epithelial migration. The barrier epithelium and the connective tissue/implant interface establish the specific biological width of the peri-implant mucosa (Berglundh & Lindhe 1996).[175] The integration of hard and soft tissues with the implant device is a dynamic process that requires several weeks of healing.

Peri-implant Mucosa and Gingiva

The soft tissue that surrounds the transmucosal part of the implant is termed the peri-implant mucosa. The structure and dimension of this mucosa have many features

in common with those of the gingiva around teeth. Besides the biological width concept that controls the thickness of the soft tissue adjacent to both teeth and implants, there are also fundamental differences between the two tissue types. Thus, the root of the tooth is covered by a root cementum from which collagen fibers run in a direction that is perpendicular to the long axis of the tooth and attach to the surrounding hard and soft tissues. The implant has no root cementum and, hence, collagen fibers are not able to attach to the implant surface in the same way as the biological and mechanical attachment of teeth. In the peri-implant mucosa, the collagen fibers are aligned in different directions and in the tissue immediately lateral to the implant surface collagen fibers are orientated parallel to the long axis of the implant. Nevertheless, the biological attachment formed by the barrier epithelium and the connective tissue part of the peri-implant mucosa provides an effective soft tissue seal to the oral environment.

Examination of Peri-implant Tissues

Increasing probing depth and loss of clinical attachment are pathognomonic for periodontal disease. Pocket probing is, therefore, a crucial procedure in diagnosis of the periodontium and for the evaluation of periodontal therapy. Reduction of probing depth and gain of clinical attachment are the major clinical criteria used to determine the success of periodontal treatment. The extent of probe penetration is influenced by factors such as the roughness of the root surface, the inflammatory state of the periodontal tissues and the firmness of the marginal cuff. Several studies have demonstrated that the periodontal probe often fails to identify the histological level of the connective tissue attachment. Probing has also a limited reproducibility; variations of 1mm have to be expected under clinical conditions. Clinical attachment level measurements reflect tissue changes that occurred in the past. Therefore, substantial, and possibly irreversible, tissue changes have already occurred once disease is detectable by clinical attachment level measurement. The advantages of probing are the simplicity of the method, the immediate availability of the results, and the ability to demonstrate topographical disease patterns. The results from a histological study determining the extent of peri-implant probe penetration in dogs indicate that the density of the peri-implant tissues influences penetration depth. In inflamed tissues around one-stage non submerged implants, periodontal probes penetrated close to the bone level, whereas the probe tips tended to stop at the histological level of connective tissue adhesion if healthy tissues were present.[176]

Quirynen et al.[177] found a correlation between the level of bone as seen on radiographs and the extent of peri-implant probe penetration. In the case of screw-type implants, the probe tip appeared to stop 1.4 mm coronally to the bone level. The mean discrepancy between probe penetration and the location of the bone margin in radiographs was 1.17 mm in 100 non submerged titanium implants 1 year after implantation.[178] Microbiological studies have shown that there is a marked difference in the composition of the peri-implant microflora between implants with deep and

shallow pockets. Pockets 5 mm deep or more can be viewed as protected habitats for putative pathogens and are a sign of peri-implantitis. Implant shape and surface texture influence the penetration of the probe tip. With some implants, peri-implant probing is impossible due to peculiarities of the design (concavities, shoulders or steps). Lack of surface smoothness (such as plasma-coating, sandblasting or the presence of threads) increases resistance to probe penetration and may lead to the underestimation of pocket depth. Some clinicians have, therefore, expressed the opinion that probing is not a good diagnostic method for implant evaluation.

The examination of peri-implant tissues is fundamental in the maintenance and follow-up of implant treated patients. The methods to be applied in the clinical examination of the tissues surrounding implants resemble those used in the examination of the periodontal tissues surrounding teeth. Thus, probing represents one of the critical assessments and includes not only the appraisal of probing pocket depth (PPD) but also the more important detection of bleeding on probing (BOP). Probing peri-implant and periodontal tissues is in most respects similar and is regarded as a predictable and reliable procedure in the effort to distinguish between healthy and diseased tissue, provided that a normal force is applied.[176]

Peri-implantitis

Peri-implantitis lesions, in contrast to mucositis lesions, exhibit characteristics that are considerably different from their periodontal counterparts. The inflammatory lesion in periodontitis around teeth is confined to the sub-epithelial connective tissue compartment of the gingiva and is separated from the alveolar bone by a 1mm-wide zone of dense connective tissue. Furthermore, the pocket area is lined by a pocket epithelium, which in its most apical portion is in contact with the root surface and thereby effectively walls off the biofilm of bacteria in the pocket.

The peri-implantitis lesions also presents with a pocket compartment that contains bacteria. In contrast to the pocket epithelium in periodontitis, however, the corresponding epithelium of the peri-implantitis lesion does not cover the entire extension of the pocket.

As a consequence, the apical third of the inflamed tissue in the pocket is uncovered and in direct contact with the biofilm. Another difference in relation to periodontitis is the extension of the inflammatory lesion in peri-implantitis.

While the lesion in periodontitis is separated from the crestal bone by a zone of connective tissue, the lesion in peri-implantitis extends to a position close to the bone surface. An understanding of these differences between periodontitis and peri-implantitis is important in the selection of strategies for treatment of the disease.

Guidelines for Follow-up of Implant Treated Patients[178]

Professional Hygiene Maintenance– Frequent recall visits during the first year after implant placement and restoration are necessary for evaluation and establishment of

good oral hygiene routines. In patients who are partially edentulous with implant-supported restorations maintenance visits combine traditional periodontal maintenance for the remaining natural teeth and dental implant maintenance. In fully edentulous patients with implant-supported restorations, the focus is on prevention or treatment of peri-implant mucositis or peri-implantitis, because dental caries and endodontic pathologic conditions are not possible. Data collection includes measurement of probing depths, bleeding upon probing, suppuration, recession, mobility, response to percussion, and clinical appearance of peri-implant mucosa.

Probing– The generalized belief is that a baseline probing depth needs to be established and any signs of change, including bleeding, redness, edema, exudate, pain, or radiographic bone loss, warrant probing. Probing should be done with very gentle force (not to exceed 0.15 N) because excessive force may disrupt the soft tissue attachment and has been shown to overestimate probing depths and the incidence of bleeding upon probing.

Baseline Radiographs– Follow-up periapical radiographs is generally taken 1 year after loading; thereafter the frequency of radiographic evaluation is determined by the clinical findings. Fixation devices and specific controls should be used to ensure that the radiograph is not distorted. Some implants with bone loss may not exhibit any clinical tissue problems or symptoms. Radiographs should be taken annually for the first three years after placement and for the life of the implant after the completion of the case.

Instrumentation– The maintenance of a smooth surface of the titanium without pits and scratches is important to prevent plaque accumulation. The most important consideration is selecting safe and efficient instruments for removing calculus and plaque. Standard metal scalers and curettes are not recommended for implant debridement due to the possibility of scratching the titanium surface. While plastic scalers are available, their effectiveness in removing hard deposits is limited; gold, titanium or vitreous carbon tipped instruments are generally more effective. Ultrasonic or piezoelectric scalers with plastic or carbon tips have also been shown to be effective without damaging implant surfaces.

Polishing– The main indication for polishing an implant is for plaque removal, since titanium surface of an implant abutment is highly polished and with proper care will rarely lose its manufacturer's polished finish. Rubber cup polishing with toothpaste, fine prophy paste, commercial implant polishing pastes, and tin oxide have been shown not to alter titanium surfaces. Coarse abrasive polishing pastes, flour or pumice for polishing, are contraindicated, as is air polishing. Implant polishing pastes available are Hawe implant paste, Proxyt.

Subgingival Irrigation– Irrigation of the implant sulcus by chemotherapeutic agents may be useful as a long-term maintenance procedure. A cannula should have non-metallic, rounded tip with side escape portals, and care should be taken while inserting it to the base of the implant sulcus to prevent fluid distention into surrounding

tissues and to avoid gouging the surface. A study by Renvert et al.[184] on non-surgical mechanical treatment on sites with peri-implantitis lesions with microencapsulated minocycline (Arestin) and 0.12% chlorhexidine gel found reductions of pocket depths and bleeding on probing for as long as 12 months.

Oral Hygiene Education and Home Care– Partially or completely edentulous patients that have dental implants generally have a history of improper dental home care. These patients may moreover have improper oral hygiene practice due to postsurgical fear of causing damage, on the one hand, or overzealous home care trying to stay absolutely plaque free, on the other hand. Either of these situations can lead to detrimental consequences. Home care for dental implant-supported restorations similar to traditional oral hygiene procedures, with some minor modifications are as follows.

Chemotherapeutic Agents– Chlorhexidine gluconate has been shown to be a major asset in reducing plaque in the oral cavity and around dental implants. Long-term use of antimicrobials may be used with brushes and floss to avoid stain accumulation.

The cumulative interceptive supportive therapy (CIST) protocol serves as guidance for the treatment of the peri-implantitis. The CIST protocol is in agreement with the systematic review presented at the 4th European workshop on periodontology in Ittingen, Switzerland, which suggested a combination of various anti-infective therapies (mechanical, antiseptic, and antibiotic) to prior surgical intervention. Depending on the clinical and eventually the radiographic diagnosis, protocols for preventive and therapeutic measures designed to intercept the development of peri-implant lesions. This system of supportive therapy is cumulative in nature and includes four steps, which should not be used as single procedures, but rather as a sequence of therapeutic procedures with increasing anti-infective potential depending on the severity and extent of the lesion.

The 4 steps are:

1. Mechanical debridement, CIST protocol A.
2. Antiseptic therapy, CIST protocol A & B.
3. Antibiotic therapy, CIST protocol A + B + C.
4. Regenerative or resective therapy, CIST protocol A+B+C+D.

❑

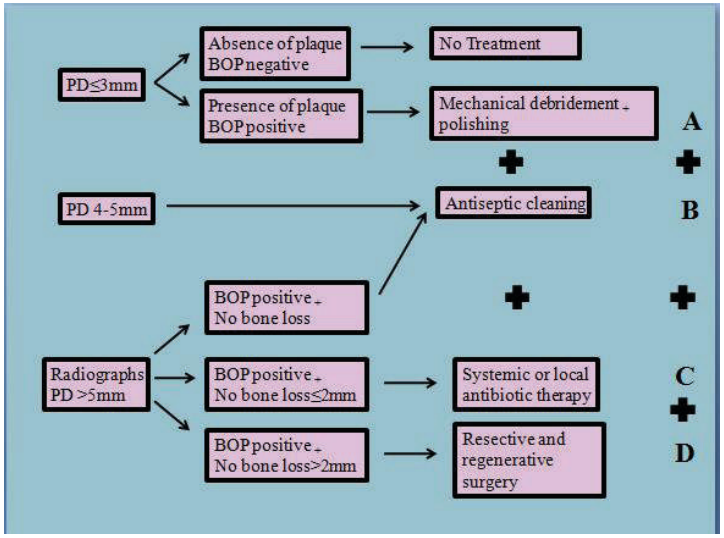

Fig. 12

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Chapter 10

Restorative Dentistry and its Effect on Periodontal Maintenance

I. Periodontal-Restorative Interrelationships[179]

The impact that dental procedures will have on the periodontium has become an important consideration in treatment planning of the restorative case. It is difficult to perform any treatment without affecting the periodontium. It may be direct or indirect, short or long lasting, positive or negative, immediate or delayed, but periodontal health will be affected.

The most sensitive indicator of the efficacy of restorations is their effect on the hard and soft tissues surrounding the tooth. The gingiva will let the professional known whether or not the contours and margin placement are biologically compatible with the soft tissues. Increased tooth mobility, fremitus and widening of the periodontal ligament seen on radiographs will indicate whether undue forces have been placed on the teeth and in turn periodontium, monitoring the probing depths before and after the placement of the restorations will show whether the attachment apparatus has been detrimentally affected. The health of the periodontium also has a direct effect on restorative dentistry. Impressions for restorations for restorative procedures are more accurate and easier to taken when there is minimal crevicular flow and no gingival bleeding.

There are aesthetic concerns when subgingival margins are exposed due to recession. A well-made prosthesis might have to be removed because of periodontal problems.

Access for Personal and Professional Cleaning– Patients must be able to clean each tooth surface and the surrounding gingival crevice. Failure to provide access for cleaning can have for reaching implications. In previously healthy sulci, this allows a shift away from bacteria associated with health towards those found in periodontal disease.

The following considerations are made for restorations:

1. Emergence Profile– It is flat in natural teeth and this form should be mimicked in the restorations. Otherwise, dental plaque will accumulate while the gingiva is forced into a unnatural position.

2. Embrasures– To allow access for the patient to remove dental plaque, restorations should have proper embrasure form. The following is suggested:

i. Labial embrasures should be open with the facial line angles not being placed too far interproximally. The contact area should be placed towards the facial aspect.
ii. Lingual embrasure with proper placement of the contact area toward the facial aspect, the lingual embrasure will be accessible for cleaning.
iii. Gingival embrasures should be open for access to cleaning by placing the contact toward the occlusal/incisal aspect.

3. Pontic Form– Pontics should have a contact with the ridge that is flat or convex while allowing complete cleaning with dental floss or other cleaning aids of the gingival surface of the pontic.

A bullet shaped pontic touching the ridge is good for mandibular posteriors areas. In the maxilla a modified ridge lap design serves well.

4. Margin Placement– The best position for margin of restorations is 1 mm or more coronal to the gingival margin. The second choice is at the margin of the free gingiva. Placing the margin is the gingival sulcus is always a compromise as far as the periodontium is concerned. If it is necessary to the margin below the tissue, the gingival crevice should be shallow and healthy. The finish line should then be placed about 1 mm apical to the crest of the gingival margin and must be clinically perfect to avoid a rapid shift toward the bacterial populations associated with periodontal diseases.

5. Biological Width– In case where sub gingival margin is necessary extreme call must be taken to avoid impinging on the sub crevicular physiologic dimension. The coronal-apical width ridges from 2 to 3 mm, with approximately half composed of JE and half of CT fibers.

This dimension tends to maintain itself even in the presence of disease or trauma. If this soft tissue is violated during restorative procedures, it may reform at a more apical level. In the periodontium this will result in gingival recession. In medium or thick periodontium the crest of the free gingival will usually remain in its original position, thus creating a periodontal pocket.

6. Marginal Fit– The crown with inadequate marginal fit below the gingiva creates problems for the periodontium. If can result in radiographic bone loss, loss of attachment, and gingival inflammation. This may be due to violation of the biologic width or more likely from increased retention of bacteria and their products.

7. Mucogingival Considerations– Failure to recognize mucogingival problems can lead to less than optimal results in terms of health and aesthetics, but intervention before restorative procedures can meliorate or eliminate most of these problems.

In areas where restorative margins will enter the gingival crevice, the patient should have 5 mm of keratinized gingival (2 mm of free gingiva and 3 mm of attached gingiva) [Maynard and Wilson 1979].[180] This suggestion seems to be supported by

a study of restorations with subgingival margins done in dogs. Ericsson and Lindhe 1984[181], Stetler and Bissada (1987).[182]

A study was conducted Stetler and Bissadaon significance of the width of keratinized gingiva on the periodontal status of teeth will sub marginal restorations. 58 teeth in 26 patients were selected. Group 2– 30 teeth with > 2.0 mm width of keratinized gingiva is mid facial aspect of the tested tooth, Group 3– 28 teeth < 2.0 mm width were divided into 2 groups. Group A– with sub-gingival restorations for 2 years and Group B– contra lateral side, with no sub-gingival restorations. Findings were:

i. Teeth with sub-gingival restorations and narrow zones of keratinized gingiva had higher gingival scores then teeth with sub marginal restorations with wide zones of keratinized gingival.
ii. Teeth without sub-gingival restoration showed number state different between narrow and wide zones of keratinized gingiva.

II. Maintenance for the Removable Prosthesis[183]

The care provided by the patient and the dentist can directly affect the effectiveness of a prosthesis, which in turn affects the periodontium.

The patient must be made aware that the denture and soft tissue must be maintained for a healthy oral cavity.

Plaque and associated microorganisms on the tissue surface of the dentures are significant factors in the pathogenesis of denture stomatitis.

A routine denture-cleaning regimen should be designed to remove and prevent re-accumulation of microbial plaque and to remove mucins, food debris, calculus and exogenous discolouration.

These are many different methods to clean dentures:

1. Mechanical denture cleansing with a brush.
2. Pastes and Powder.
3. Ultra sonic agitation.
4. Chemical denture cleansing with alkaline peroxide or alkaline hypochlorite.

III. Maintenance for Fixed Prosthodontics[184]

1. Maintenance of the Composite Resin Restoration

At each maintenance visit, evaluate the composite resin restoration for surface smoothness, marginal adaptation and appearance.

Certain prophylactic procedures can create problem for composite resin restorations:

i. Polishing with pumice will dull the surface and should be avoided.
ii. If polishing is necessary, it should be done with diamond polish, sof-lex disks or commercially available composite polishing pastes.
iii. Commonly used prophylactic devices, such as air powder abrasive machines and ultrasonic scalers, can be deleterious to these restorations.

2. Maintenance of Amalgam Restorations

Amalgam restorations are inspected for signs of failure, areas of roughness, overhangs and ditching.

Polish the amalgam with pumice and amalgloss to create a smoother, less plaque, retentive surface.

If overhangs cannot be replaced, they can be minimized by ultra sonic instrumentation, rotary or reciprocating hand pieces and abrasive strips.

3. Full Crown Restorations

The full or partial veneer crown itself usually poses few maintenance problems. Besides crown displacement or occlusal adjustment, the following should be considered:

i. Recurrent caries in marginal areas– Where areas of decay occur at crown margins that are accessible, repairs may be possible. Repair should be considered only if the placement can ensure adequate marginal integrity and contour.

ii. Care for marginal integrity– Scaling and root planing around metal crown margins should be done where possible with a circumferential stroke to avoid disturbing the margin.
   a. Ultra sonic scalers should not be used.
   b. Gentle root planning is done around porcelain labial margins and around porcelain jacket crowns. Avoid using ultrasonic scalers.

iii. Porcelain fracture– If a fracture occurs due to framework failure, it is ideally replaced. If occlusal forces were judged to be the cause, those factors should be altered or corrected.

4. Multiple Restorations

Patients with multiple restorations should have special attention paid to occlusion. In some instances they may need habit appliances to minimize occlusal trauma. This serves to protect restorations and a compromised periodontium.

The patient who has been restored in conjunction with periodontal therapy has more challenging maintenance problems than the patient with a healthy periodontium. The patient often has less supporting bone around remaining teeth and multiple missing teeth. They generally have multiple abutted, long span fixed partial dentures, a splinting to control mobility and complicated occlusal patterns. These patients cannot afford additional bone at tooth loss and need to understand that careful home care and frequent maintenance intervals all mandatory.

Points of considerations for these patients include:

1. Proper maintenance intervals for re-evaluation and adjustment (at least every 3 months).
2. Aggressive and frequent home call and instruction.

3. Tag out and recementation where applicable.
4. Timely replacement or repair.
5. Periodic occlusion adjustment and habit appliance therapy.

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Chapter 11

Supportive Periodontal Therapy in Orthodontic Patients

I. Before Orthodontic Treatment

Every potential candidate for orthodontic therapy should undergo periodontal screening before tooth movement begins; the following should be evaluated for:

Oral Hygiene– It is important for the potential orthodontic candidate to have optimal oral hygiene. Absence of proper cleaning can have extremely negative consequences for those who have periodontitis before tooth movement starts. Each individual should be taught to use the most effective means possible for interproximal cleaning.

Inflammatory Periodontal Diseases– If any problems are found they should be corrected before orthodontic therapy is begun. Scaling, root planning or flaps can be raised. However, bone removal is not done at this stage.

Trauma from Occlusion– Also eliminated before orthodontic therapy is begun.

Mucogingival Problems– When oral hygiene is optimal and orthodontics is not to be done, grafts are seldom needed. However, because perfect oral cleanliness is rare, grafts may be needed before tooth movement begins, because if all the teeth moved through the cortical plate, recession often occurs in a thin periodontium.

Grafts are generally placed in the following conditions:

1. 1 mm or less of attached gingiva.
2. Thin gingival tissues.
3. Less than optimal oral hygiene.
4. When the tooth is to be moved and held in a prominent position.

II. During Orthodontic Care

Following are to be looked for:

Oral Hygiene– Monitored recorded and improved. Using well trimmed, bonded brackets and keeping bands as far away from the base of the sulcus leaves more room for effective cleaning.

Inflammatory Periodontal Disease– Patient is seen for periodontal prophylaxis similar to other patients with these problems.

Trauma from Occlusion– Fremitus monitored and eliminated. In extreme cases disarticulating devices are used.

Mucogingival Problems– Monitored for and treated.

III. After Orthodontic Care

Oral Hygiene– is monitored as with other patients

Inflammatory Periodontal Disease– Patient is kept on appropriate maintenance then re-evaluated 6 months after tooth movement ends. At this time, any remaining deepened probing depths should be dealt with.

Trauma from Occlusion– Monitory of fremitus and tooth mobility continued and evaluated 6 months after cessation of active orthodontics. At that time a final treatment plan to control the occlusion should be developed.

Mucogingival Problems– It frequently takes time for gingival recession to occur after orthodontic treatment has been completed. Therefore, this parameter must be closely monitored.

Aggressive periodontitis (AP) is a condition that promotes breakdown of the periodontal tissues in a short time. In severe cases, pathologic migration of teeth and tooth loss can occur, producing aesthetic and functional problems for the patient. Orthodontic treatment may be recommended to restore aesthetics and masticatory function. In a study done by Carvalho CV et al.;[186] it was concluded that the periodontal parameters of the AP patients remained stable during orthodontic treatment under strict biofilm control.

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Chapter 12

Supportive Periodontal Therapy in Patients on Radiation Therapy

I. Prior to Radiation Therapy

The periodontal status of the remaining dentition is the single most important part of the pre-radiation evaluation.

The following is preformed:

1. A complete periodontal examination.
2. A consultation with the radiation oncologist, where details of amount of radiation and areas to be radiated can be ascertained.
3. Periodontist should decide whether teeth within radiation field should be retained because extraction during radiation therapy can cause negative consequences.

II. During Radiation Therapy

The patient might suffer from mucositis, xerostomia, altered taste activity, radiation-caries, trismus, edema and osteoradionecrosis. Palliative treatment is given.

III. Maintenance Therapy

Maintenance of the remaining dentition during and following radiation requires that the patient be placed on adequate oral hygiene routine that includes application of topical fluoride.

Keene et al.[194] reported a 100-fold increase in the concentration of the caries associated streptococcus mutans in the posterior irradiated xerostomic mouth. It is mandatory that the patients be placed on topical fluoride 1% sodium fluoride or 0.4% stannous fluoride gel in custom–fabricated tray or a brush on method stannous fluoride has additional benefit of plaque inhibition.

Candida albicans population may increase upto 100-fold following radiation therapy (Chen et al. 1974).[195] These fungal infections appear as erythema, burning sensation in mucosa or angular chelitis. Antifungal therapy is instituted for these patients.

Routine dental procedures such as oral prophylaxis, removable partial denture and fixed partial denture fixation and non-surgical endodontic treatment can be performed.

Periodontal root planning if needed, should be accompanied by antibiotics. In general, these patients should be seen every 3 months have bitewing radiographs taken every 6 to 12 months and have a full series of radiographs taken every 2 years.

Patients undergoing radiotherapy to the head and neck region with or without chemotherapy do not show aggravations of their clinical periodontal status for up to 6 months after cancer treatment if they also receive periodontal therapy and maintenance.[196]

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Chapter 13

Supportive Periodontal Therapy for Chemotherapy Patients

In general, these patients present only acute problems during their chemotherapy. The systemic medications that are toxic to the rapidly dividing cancer cells also affect the oral cavity.

If the periodontium is healthy, the chemotherapy usually has no noticeably negative effects on the periodontium. If problems arise; it should be treated in conjunction with the oncologist. Frequently prophylaxis is helpful during and for about a year after medication to help the periodontium remain stable.

Re-Treatment

One very important aspect of maintenance care is to diagnose the pockets where the initial treatment was inadequate so another attempt can be made to remove irritants on the root surface, as well as to prevent significant re-population of pathogenic bacteria in the treated pockets. It has been suggested that need for re-treatment can be tested by bacterial counts (Keyes et al. 1975, Listgarten et al. 1981),[198,199] but no specific organisms, or group of organisms have yet been selectively implicated as casual agents for chronic periodontal disease, and the significance of the bacterial counts is very controversial when used for diagnosis of individual disease sites. Although it has been claimed on the basis of short-term studies that clinical signs of redness, bleeding on probing and suppuration are poor predictors of periodontal disease activity as measured by attachment loss (Haffajee et al. 1983).[200] This claim should be re-evaluated over a longer period of time and with more cases. When patients are examined at the time of recall every 3 months, gingival bleeding to probing is very common and may have nothing to do with the status at the deeper parts of the pockets. However bleeding to gentle probing 2-3 weeks after the recall prophylaxis and instructions indicates root surface irritants. Re-treatment in cases of bleeding, and/or pus may halt the progressive periodontitis (Ramfjord et al. 1987),[23] while in other instances with inaccessible furcas or residual calculus the bleeding tendency and the breakdown may continue in spite of frequent recalls and good oral hygiene.

Incomplete removal of subgingival plaque and calculus during periodontal therapy with (Caffesse et al. 1985)[201] or without (Rabbani et al. 1981)[202] flap surgery

apparently is more common than generally assumed (Hunter et al. 1984)[203] and clinically acceptable results may (Knowles et al. 1979, Caffesse et al, 1985)[21,201] be attained in spite of the fact that microscopic remains of plaque and calculus inadvertently may be left on the roots, especially when deep pockets are treated. According to recent findings (Hunter et al. 1984)[203] appears likely that microscopic specks of calculus and/or plaque may be present on root surfaces even if they appear clean to the naked eye during surgical exposure. Such remaining accretions may potentially be more-or-less harmful, dependent on total mass and type of bacteria and toxins. The root surface in a pocket that bleeds during gentle probing should be rescaled, and if the bleeding continues, it should be exposed surgically and planed even if no calculus is visible. Bleeding on gentle probing indicates inflammation and less than ideal result of the treatment, although the pocket depth may not increase to a measurable extend. Magnifying glasses should be used during periodontal surgery.

Pockets that secrete pus or bleed from the bottom of the crevice during recall examination should be noted on the record and the teeth scaled as part of the professional tooth cleaning; such patients should then be called back in 2-3 weeks to be tested by the dentist or periodontist. If the pockets still bleed, it is up to the dentist to decide what may be done to eliminate the source of irritation further root planing with or without surgical exposure. If the bleeding is from a furcation which previously has proven to be inaccessible, the tooth may be given up as an unavoidable loss or left as long as it is asymptomatic. Pockets with significant loss of attachment (> 2 mm) during maintenance therapy should be routinely retreated, usually by a simple small mucoperiosteal flap, and the roots planed or by scaling and root planing only (Ramfjord et al. 1986).[23]

If the professional tooth cleaning at recall visits is performed by persons who are good at scaling teeth, the chances are that the calculus overlooked during the initial treatment or previous visits, is found and removed, while if the recall is mainly a supragingival plaque removal and polishing session, minute subgingival irritants are often overlooked.

Much interest is currently focused on use of antibiotics both for treatment and maintenance care of periodontitis patients (Ciancio and Genco 1983).[204] However, the results from bacteriological and clinical studies are confusing, and these methods are as yet not ready for routine clinical application. It appears that antibiotic therapy alone for periodontal disease will not provide satisfactory long-term results. Antibiotics in addition to mechanical therapy may enhance at least the short term responses to the treatment, but a combination of drugs and mechanical modalities of therapy has not been shown to have any long-term advantage over periodic mechanical recall therapy alone. However, a few patients with recalcitrant periodontitis may at least over the short-term get some benefit from antibiotics in addition to the mechanical therapy (Slots et al. 1979),[205] and it may lead to temporary healing of a periodontal abscess. But this healing has to be augmented by mechanical therapy to assure long-term benefit.

Professional supra and subgingival plaque removal once a month for 3-4 months and then every 2 months for another 3-4 months has been found to be more helpful than antibiotics in progressive periodontitis where recall every 3 months did not stop the progress of the disease.

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Chapter 14

Complications Seen During SPT

One of the objectives of periodontal therapy is to prevent tooth loss. Once the periodontal therapy is completed, SPT should be aimed at preventing further loss of teeth as a consequence of periodontitis or treatment of periodontitis. Several studies have demonstrated that tooth loss cannot be completely prevented by cause related periodontal therapy.[206,207] It also appears that tooth loss occurs in subsets of subjects and that risk-profiling subjects on SPT might allow prevention or reduction in tooth loss in subjects on SPT.[208]

Caries

Few studies have specifically addressed root caries as a complication during a period of SPT. However, studies suggest that the prevalence of root caries in periodontally treated patients is very high.[209] One of the consequences of periodontal therapy is the removal of root cementum. It has been suggested that intact root cementum prevents dentin caries.[196] Due to the potential of exposed root surfaces without root cementum as result of initial therapy, and further removal of dentin during SPT, subjects susceptible to caries are at a high risk for root caries. In a study of patients who had received periodontal therapy and were on routine SPT, the data suggested an association between the level of oral hygiene and the number of root surface lesions and likewise an association with salivary streptococcus mutans counts. However, no relation was found between previous experiences of coronal caries, salivary flow rate, or salivary buffer capacity and root lesions. Studies have also shown a relationship between root caries and subgingival presence of S. mutans.[210] Molars treated with root resection also carry a higher risk of root caries, resulting in treatment failure in spite of SPT.[211] Therefore, repeated oral hygiene instructions and adjunctive preventive measures including diet counselling and fluoride rinses, as well as fluoride and chlorhexidine varnishes, should be advocated in high-risk patients on SPT.[78] An extensive review of the use of fluorides in the management of patients with periodontitis in preventing caries has been published.[212]

Endodontic Lesions

Endodontic complications during SPT may result in tooth extraction. Data suggests that approximately 30% of all extractions of teeth over a 4-year period of SPT are the

consequence of peri-apical lesions.[213] Additional information about the relationship between periodontitis and endodontic lesions was recently published.[214]

Periodontal Abscesses

Periodontal abscesses appear to occur in approximately 35% of subjects on SPT and predominantly in subjects who can be identified as rapid downhill cases.[215] It appears that subjects on SPT who only received non-surgical therapy during the ICRT may be at a greater risk of periodontal abscesses during the SPT phase.[66]

Root Sensitivity

It is well established that following ICRT, root sensitivity is common, especially if treatment involved surgical procedures. In most cases such sensitivity decreases over time. Reports on root sensitivity during SPT vary from 15% to 98% and are often associated with root surface exposure and gingival recession.[216-218] The very high prevalence of root sensitivity reported by Chabanski et al.[216] was based on patients previously treated for periodontitis. Data confirm that meticulous plaque control will diminish root sensitivity. Treatment of root sensitivity is consistent with preventive measures of root caries.

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Chapter 15

Conclusion

Irrespective of the type of active periodontal therapy performed in the absence of sufficient maintenance care, the results thus obtained cannot be sustained over a long period of time and the periodontal health of patient inevitably deteriorates.

It is the combination of periodic professional monitoring, debridement of teeth, fluoridation, detailed and uncompromising construction of individual home care techniques by the dental team and ensuring optimal daily plaque control by a well informed trained and motivated patient that determines almost exclusively the success of dental therapy.

Supportive periodontal therapy makes it easier for both the compliant patient and the health professional charged with accomplishing debridement at the professional level to help control the circumstances that led to inflammatory periodontal diseases.

Successful periodontal and implant therapy with regular periodontal maintenance can promote periodontal and peri-implant health. Following surgical or non-surgical periodontal therapy, an interval is established for periodic ongoing care. Periodontal maintenance is not synonymous with prophylaxis. There is a preponderance of evidence in the literature that periodontal and other oral diseases, such as caries, can be treated and controlled by thorough mechanical plaque removal by the patient, the use of antimicrobial agents and antibiotics when necessary, and participation with the therapist in a well monitored, long-range program of supportive periodontal therapy.

Recent evidence suggests that the control and prevention of oral disease, especially periodontitis, is especially important for patients with various systemic conditions that can be impacted by oral infections. It is far better for patients and therapists to practice primary and even secondary prevention with effective plaque control and regular, consistent supportive periodontal therapy, than having to rely on tertiary prevention for disease that has progressed to a level that requires costly treatment, is time-consuming and carries a greater risk of morbidity. Periodontal treatment success, including both non-surgical and surgical therapy, is dependent on appropriate maintenance.

Periodontal maintenance therapy also applies to dental implants, as they have been shown to be susceptible to peri-implant disease. In addition, long-term control of periodontal inflammation may reduce the risk of several systemic diseases and conditions. It is the general practitioner's responsibility to evaluate each patient's dental

history and prescribe appropriate periodontal and peri-implant maintenance care, as well as to identify when conventional treatment is failing and to execute a prompt and appropriate solution, which includes use of adjunctive agents, surgery, or referral to a periodontist. The keys to success include consistent reminders sent to the patients on the importance of long term maintenance in preventing periodontal or peri-implant disease progression, as well as early identification and treatment of inflammatory and biomechanical problems to minimize their impact. This will maximize the likelihood of maintenance of natural teeth and dental implants in health, comfort, function, and aesthetics for the duration of the patient's life. A successful long-term maintenance program is based on semantics and good communication. This involves informing the patients of their current periodontal status and any alterations in treatment, if indicated, consultation with other health care providers who will be providing additional dental care or participating in the supportive periodontal treatment program, and future planning. For patients with a history of active periodontitis, visits at 3-month intervals are recommended. However, the scheduling of future patient supportive periodontal treatment visits should be based on evaluation of clinical findings and assessment of disease status. Supportive periodontal treatment visit frequency may be modified, or the patient may be returned to active treatment. The success of any supportive periodontal treatment program is based on periodic evaluation and appropriate re-treatment if indicated. The ultimate goal of treatment is preservation of the dentition in health and function.

After osseointegration has been confirmed and the final prosthesis or restoration is complete, the patient is largely responsible for the success of an implant. Patient needs to understand the importance of proper in-surgery implant maintenance appointments every 3 months for the first year to help prevent infection or failure of the implant. After one year a mature level of bone surrounds the implant, and the interval between maintenance visits should be based on the patient's general health, assessment of the implant, and home care. The dental hygienist or therapist plays a key role in the success of dental implants for the patients by providing the education, assessment, and safe implant maintenance and home care recommendations.

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Chapter 16

Review of Literature

Biologic Basis and Rationale for Periodontal Maintenance

Per Brandtzaeg and Homer C. Jamison in 1964[30] had assessed the periodontal health and oral hygiene of 206 Norwegian Army recruits twice. Approximately 35 days elapsed between the two examinations. Russell's scores of PI were used to assess periodontal health, and scores of OHI and DI were used to assess oral hygiene and debris on the teeth. 102 of these men received special instructions in cleansing the teeth, and 104 men who did not receive such instructions were designated controls. The records of 101 controls and 99 test subjects were analysed. It was concluded from the study that:

1. Oral hygiene was significantly related to tobacco consumption and to number of unfilled cavities;
2. Periodontal health and oral hygiene were not significantly related to the reported frequency of tooth brushing;
3. Periodontal health and oral hygiene were improved in patients who followed oral hygiene instructions in cleansing the teeth;
4. There were significant direct relationships between changes in scores of PI, oral hygiene and debris on the teeth;
5. Neither changes in oral hygiene, nor changes in the amount of debris on the teeth, accounted for all of the improvement in periodontal health which accompanied improvement in cleansing of the teeth.

Tribhawan N. Chawla, Ram S. Nanda and Kamal K. Kapoor in 1975[30] conducted a study on 2,950 male subjects; 1300 children of 12±1 and 1300 of 15±1 years of age from the rural schools, and 350 adults 26±2 years of age were selected among the factory workers around the city of Lucknow. These subjects provided a homogeneous sample due to the uniformity in socio-economic factors and total lack of awareness towards dental health care and the modern methods of achieving tooth cleanliness by a tooth brush and/or scaling. Only male subjects were considered due to non-availability of female rural school going children. The sample was divided into one control and five experimental groups. The study lasted for a period of two years and the subjects in all of the groups were assessed for gingivitis, loss of attachment, calculus and

plaque. Periodontal disease (including gingivitis and loss of attachment) and calculus accumulation showed considerable reduction ($P < 0.01$) with any type of treatment. Scaling alone will not reduce the plaque formation for which regular tooth brushing is essential. Yearly and half-yearly scaling along with tooth brushing instructions will considerably improve and maintain the oral hygiene thereby reducing the prevalence and severity of periodontal disease, plaque, and calculus accumulations. However, more intensive measures (quarterly prophylaxis) will further improve the periodontal health and reduce calculus accumulation. The apical migration of the epithelial attachment can practically be stopped by rendering scaling half yearly, without any instructions in oral hygiene and elimination of dental plaque.

Sture Nyman, Jan Lindhe, Bengt Rosling in 1977[39] conducted a clinical trial to study the results of periodontal treatment following different modes of periodontal surgery in patients not recalled for maintenance care. The material consisted of 25 patients distributed into 5 groups. Following an initial examination, all patients underwent pre-surgical treatment including case presentation and instruction in oral hygiene measures. This instruction was given once. The various patient groups were then subjected to one of the following surgical procedures:

1. The apically repositioned flap operation including elimination of bony defects.
2. The apically repositioned flap operation including curettage of bony defects but without removal of bone.
3. The “Widman flap” technique including elimination of bony defects.
4. The “Widman flap” technique including curettage of bony defects but without removal of bone.
5. Gingivectomy including curettage of bony defects but without removal of bone.

6, 12 and 24 months after completion of the treatment, the patients were recalled for assessment of their oral hygiene standard and periodontal conditions. The results showed that case presentation and oral hygiene instructions given once, only temporarily improved the patient's oral hygiene habits. Renewed accumulation of plaque in the operated areas resulted in recurrence of periodontal disease including a significant further loss of attachment. All five different techniques for surgical pocket elimination were equally ineffective in preventing recurrence of destructive periodontitis. J. Lindhe, A.D. Haffaiee, S.S. Socransky in 1983[41] monitored progression of periodontal disease in adult subjects in the absence of periodontal therapy in 2 population groups. One group of 64 Swedish subjects (mean age 40.5 years at entry) with mild to moderate periodontal attachment loss was monitored for attachment level changes at baseline, 3 and 6 years. A second group of 36 Americans (mean age 34.3 years at entry) with advanced destructive periodontal disease was monitored for attachment level changes at baseline and 1 year. Of 4101 sites examined at baseline and at 3 years in the Swedish subjects, only 158 sites (3.9%) showed attachment loss of more than 2 mm. No measurable change was found in 1440 sites (35.1%). Of 4097

sites examined at 3 and 6 years, 67 sites (1.6%) showed attachment loss greater than 2 mm; 57.4% of sites showed no measurable change; and 19 sites (0.5%) showed a decrease in probe-able attachment level of more than 2 mm. During the 6-year interval, 523 sites (11.6%) showed attachment loss of more than 2 mm; 20% of sites showed no measurable change and 11 sites (0.2%) showed more than 2 mm of attachment "gain". Approximately 50% of sites that showed no measurable change in the first 3-year period showed loss in the next 3 years. In contrast, of the sites which showed some level of attachment loss in the first period, approximately 2/3 showed no loss in the second monitoring period. Of 3210 sites monitored in the American subjects, 102 sites (3.2%) exhibited more than 2 mm of additional attachment loss; 26% of sites showed no measurable change and 138 sites (4.3%) showed a decrease in probe-able attachment level of more than 2 mm. The association between attachment level changes and initial attachment level (baseline) was examined by regression analysis. The slopes of the regression lines for both populations were not consistent with a hypothesis that sites with more advanced attachment loss are more prone to additional destruction, in the absence of treatment, than sites with initially less attachment loss. In the American group, some sites with initially advanced attachment loss, exhibited a decrease in probing attachment level.

According to Richard Chace in 1977;[5] periodontal disease has a greater or lesser tendency to recur. The therapist controls rather than cures the condition. Careful maintenance is as important as skilful original treatment if periodontal health is to be maintained. At the time of the original treatment, every patient should be informed that re-treatment of some type is occasionally necessary. Patients with recurrence of disease should be treated as conservatively as possible and every effort should be made to find the cause of failure. Surgical re-treatment should be done only after a reasonable effort has been made to improve the situation by other means. The deepened crevice that does not bleed when probed and is not accompanied by bone loss does not provide justification for surgical re-treatment.

P. Axelsson, J. Lindhe in 1978[29] carried out an investigation to determine if the occurrence of caries and the progression of periodontitis can be prevented in adults, and maintained at a high level of oral hygiene by regularly repeated oral hygiene instructions and prophylaxis. An attempt was also made to study the progression of dental diseases in individuals who received no special oral hygiene instructions but regularly received dental care of a traditional type. Two groups of individuals from one geographic site were recruited in 1971-72 for the trial; 375 were assigned to a test and 180 to a control group. A baseline examination revealed that the socio-economic status, the oral hygiene status, the incidence of gingivitis and the caries experience were similar among the test and control participants prior to the start of the study. During the subsequent 3-year period, the control patients were seen regularly once a year and given traditional dental care. The test group participants, on the other hand, were seen once every 2 months during the first 2 years and once every 3 months during the third

year. On an individual basis they were instructed in a proper oral hygiene technique and given a careful dental prophylaxis including scaling and root planing. Each prophylactic session was handled by a dental hygienist. A re-examination was carried out towards the end of the third treatment year. The results of the trial clearly showed that it is possible, by regularly repeated tooth cleaning instruction and prophylaxis, to stimulate adults to adopt proper oral hygiene habits. The findings also demonstrated that persons who utilized proper oral hygiene techniques during a 3-year period had negligible signs of gingivitis, suffered no loss of periodontal tissue attachment, and developed practically no new carious lesions. The control patients, who during the same period received merely symptomatic treatment, suffered from gingivitis, lost periodontal tissue support and developed several new as well as recurrent, carious lesions. These results indicate that dental treatment is a highly ineffective means of curing caries and periodontal disease.

J. W. Knowles et al. in 1979[21] conducted a study where patients were included in a 5-year follow-up in 1975. 78 patients who had completed at least the first year recall and scoring were included in the study. They had a total of 1974 teeth (an average of approximately 25 teeth). At the 5-year postoperative recall there were 72 patients, and at 6 years, 64. However, this number fell off to 43 patients with 1038 teeth after 8 years indicating that it becomes difficult to extend a longitudinal study with regimented recall beyond 5years of follow-up.

P. Axelsson and J. Lindhe in 1981[3] had done a study to assess the efficacy of a maintenance care program to prevent recurrence of disease in patients subjected to treatment of advanced periodontitis. In addition, the periodontal status was monitored of a group of patients who following the end of active treatment were referred back to general practitioners for maintenance care. The material consisted of 90 patients who in 1972 were referred for specialist treatment of advanced periodontal disease. The patients were first subjected to an initial examination including assessment of oral hygiene, gingivitis, probing depths and attachment levels. They were instructed how to practice proper tooth-cleaning methods, their teeth were scaled and eventually the periodontal pockets were treated using the modified Widman technique. During the first 2 months following the surgery, patients were recalled once every 2 weeks for professional tooth-cleaning. Two months after the end of surgical treatment, the patients were re-examined to provide baseline data. Every third patient was thereafter referred back to the general dentist for maintenance care. Two out of three patients were maintained in a carefully designed and controlled maintenance care program at the university clinic. This program involved recalls once every 2-3 months and included instruction and practice in oral hygiene, meticulous scaling and professional tooth-cleaning. The patients were re-examined 3 and 6 years after the baseline examination. The results demonstrated that in patients suffering from destructive periodontitis, a treatment program that involved oral hygiene instructions, scaling, root planing and modified Widman flap procedures resulted in the establishment of clinically healthy

gingiva and shallow pockets. Patients who were placed on a carefully designed recall program were over a 6-year period able to maintain excellent oral hygiene standards and unaltered attachment levels. In contrast, patients who subsequent to active treatment were not maintained in a supervised program showed obvious signs of recurrent periodontitis at the follow-up examinations.

Elisabeth Westeelt, Sture Nyman, Sigmund Socransky, Jan Lindhe in 1983,[24] studied the significance of frequently repeated professional tooth-cleaning for healing results following periodontal surgery. 24 patients suffering from moderately advanced periodontal disease were selected for the study. Following a Baseline examination comprising assessment of oral hygiene status, gingival conditions, probing depths and attachment levels, all patients were given detailed instructions in proper oral hygiene measures. They were then subjected to periodontal surgery using the modified Widman flap procedure. During the initial 6 months after surgery all patients were enrolled in a maintenance care program which included measures such as scaling and professional tooth cleaning. The patients were randomly distributed into 3 different maintenance care groups. 8 patients (Group 1) received maintenance care once every 2 weeks, another 8 patients (Group 2) received a similar treatment once every 4 weeks while the remaining 8 patients (Group 3) were recalled once every 12 weeks. Following a re-examination at the termination of this 6-month period the recall program was changed. Thus, during the subsequent 18 months of maintenance (the maintenance phase) all 24 patients were recalled for prophylaxis once every 3 months. A final re-examination was performed 24 months after completion of active therapy.

The re-examination performed 6 months after surgery revealed that patients who had been recalled for professional tooth-cleaning once every 2 weeks had low numbers of inflamed gingival units and deep (> 3 mm) periodontal pockets and test subjects recalled less frequently exhibited an increasing number of inflamed gingival units and deep pockets. In addition, the frequency of sites exhibiting attachment loss of > 1 mm was closely related to the frequency of maintenance care. Patients recalled once every 12 weeks for maintenance therapy had 3 times the number of sites with attachment loss (> 1 mm) as compared to those who were recalled once every 2 weeks.

Bruce L. Pihlstrom, Richard B. McHuon, Thomas H. Oliphant, Cesar Ortiz-Campos in 1983[25] in their article had mentioned that there are many well designed clinical studies that have established the effectiveness of periodontal therapy. Surgical procedures have been shown to be effective in treating periodontitis when followed by appropriate maintenance care. Scaling and root planing alone have been compared to scaling and root planing plus soft tissue surgery in several longitudinal trials. A review of the literature indicates several important findings including a loss of clinical attachment following flap procedures for shallow (1-3 mm) pockets and no clinically significant loss after scaling and root planing. These studies also generally report either a gain or maintenance of attachment level for both procedures in deeper pockets (≥ 4 mm). For these pockets, neither procedure has been shown to be uniformly superior

with respect to attachment gain. All reports indicate that both treatment methods result in pocket reduction. However, the literature also indicates that scaling and root planing combined with a flap procedure results in greater initial pocket reduction than does scaling and root planing alone. This difference in degree of pocket reduction between procedures tends to decrease beyond 1-2 years. It has been shown that both treatment methods result in sustained decrease in gingivitis, plaque and calculus and neither procedure appears to be superior with respect to these parameters. Study at the University of Minnesota indicates that similar results are maintained up to 6½ years following active therapy. Pocket depth did not change for shallow (1-3 mm) pockets treated by either scaling or root planing alone or scaling and root planing followed by a modified Widman flap. For pockets 4-6 mm, both treatment procedures resulted in equally effective sustained pocket reduction. Deep pockets (≥ 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. However, as compared to baseline, pocket reduction was sustained to 6½ years with the flap and only 3 years with scaling and root planing alone. After 6½ years, sustained attachment loss in shallow (1-3 mm) pockets was found after the modified Widman flap. Scaling and root planing alone in these shallow pockets did not result in sustained attachment loss. For pockets initially 4-6 mm in depth, attachment level was maintained by both procedures but scaling and root planing resulted in greater gain in attachment as compared to the flap at all time intervals. Treatment of pockets ≥ 7 mm in depth by either procedure resulted in a sustained gain in attachment with no difference between procedures. The results of these studies indicate that both scaling and root planing as well as scaling and root planing combined with a flap procedure are effective in treating periodontitis over time up to 6½ years.

Anita Badersten, Rolf Nilveus, Jan Egelberg in 1984[26] had investigated healing events following non-surgical periodontal therapy in patients with periodontal pockets up to 12 mm deep. Incisors, cuspids and premolars in 16 patients were treated by plaque control and supra and subgingival debridement using hand or ultrasonic instruments in a split mouth approach. The results were evaluated by recording of plaque scores, bleeding on probing, probing pocket depths and probing attachment levels. Minimal change in gingival conditions occurred during the initial 3 months of experimentation, which were utilized for plaque control measures alone. Subsequent to instrumentation and during the following 9-month period, a gradual and marked improvement of periodontal conditions took place. During the remaining 12 months of the 24-month experimental period no further changes of the recorded parameters were noted. No differences in results could be observed when comparing hand versus ultrasonic instrumentation, or when comparing the results of 2 different operators. Initially, a total of 305 sites demonstrated probing pocket depths 7 mm. At the 24-month examination 43 such sites remained. The results indicate that there is no certain magnitude of initial probing pocket depth where non-surgical periodontal therapy is no longer effective.

Lars-Åke Johansson, Britt ÖSter, Sven-Erik Hamp in 1984[42] had done an evaluation of the long-term clinical effects of an intense period of cause-related periodontal therapy provided by dental hygiene students, was made in patients with moderately advanced periodontitis. By the evaluation, we also intended to gain information about compliance with given recommendations for periodontal health maintenance. The results after 3 years without supervision by the specialist team showed that achieved beneficial effects on the gingival conditions were maintained despite a significant increase in plaque prevalence. Recommendations as to the daily use of a variety of additional oral hygienic measures besides tooth brushing met with a considerable lack of compliance. Maintenance visits to the referring general practitioner were mostly made once a year and included regular dental care. Despite this, no further deterioration of periodontal status was observed. The results indicate that it may be possible to maintain successful effects of periodontal therapy in this patient category with less personal and professional effort than traditionally recommended.

Jan Lindhe and Sture Nyman in 1984[22] evaluated the periodontal conditions of a group of patients who, following active treatment of extremely advanced periodontal disease, had been maintained for 14 years in a well-supervised maintenance care program. The sample included 61 subjects out of an initial group of 75 individuals who in 1969 were referred to and treated by the authors. Following an initial examination, the patients were given detailed instructions in proper plaque control measures and were subjected to scaling and root planing and surgical elimination of pathologically deepened pockets. After the termination of the active treatment phase, the patients were placed in a maintenance care program including recall appointments every 3-6 months. At the initial examination, immediately after the completion of the active treatment phase and then once a year, all patients were examined regarding oral hygiene, gingival conditions, probing depths and clinical attachment levels. In addition, the interproximal alveolar bone height was determined from full mouth radiographs obtained before active treatment, at the completion of active therapy and 1, 3, 5, 8, 10, 12 and 14 years after treatment. The results from the repeated examinations demonstrated that treatment of advanced forms of periodontal disease resulted in clinically healthy periodontal conditions and that this state of "periodontal health" could be maintained in most patients and sites over a period of 14 years. It was also demonstrated that the treatment and maintenance programs described were equally effective in young and older patients. The individual mean values describing probing depths, attachment levels, and bone heights did not vary significantly over the 14 years of observation. A more detailed analysis of the data revealed that a small number of sites in a few patients lost a substantial amount of attachment. This attachment loss occurred at different time intervals during the course of the maintenance period. Thus, 43 surfaces in 15 different patients were exposed to recurrent periodontal disease of a significant magnitude. This recurrent inflammatory periodontal disease caused the loss of 16 teeth in 7 different patients during the maintenance period.

William Becker, Burton E. Becker, and Lawrence E. Berg[4] in 1984 had done a study on 44 patients who were treated for periodontal disease and for varying reasons elected not to participate in the maintenance aspect of periodontal care. All patients were initially given intensive instructions in personal oral hygiene, along with initial scaling and root planing. Each patient had two or more quadrants of pocket reduction therapy. Tooth mortality revealed a mean annual adjusted tooth loss rate of 0.22 (4.7%). Between examinations, breakdown in the health status of furcations was noted. Mean probing depth scores at the second examination showed no significant differences from the first examination scores. Measurements of bone levels revealed a worsening of bone scores between examinations. The results of this study show that periodontal therapy without maintenance is of little value in terms of restoring periodontal health.

Store Nyman, Bengt Rosling, Jan Lindhe in 1985[27] had done an investigation to find out whether favourable conditions for healing after periodontal surgery would develop in patients whose oral hygiene was professionally maintained at a high standard. The study was performed on 20 patients with advanced periodontal disease. Following an initial examination, comprising plaque index and gingival index scoring, measurement of pocket depths and loss of attachment, the patients were randomly distributed between a test and a control group. The patients first received detailed instructions for oral hygiene and were then subjected to periodontal surgery with the reverse bevel flap procedure. After surgery, the patients of the test group received professional cleaning of the teeth once every 2 weeks. The patients of the control group were recalled for scaling of the teeth once every 6 months. All patients were re-examined after 6, 12 and 24 months. It was found that the control patients were unable to maintain a high standard of oral hygiene with the result that the treatment of the periodontal disease failed. The patients of the test group maintained a high standard of oral hygiene, and the treatment of the periodontal disease was, therefore, successful.

The longitudinal effects of periodontal therapy without a frequent periodontal maintenance program has been minimally documented by C.H. DeVore, J.E. Duckworth, F.M. Beck, M.J. Hicks, F.W. Brumfield, and J.E. Horton in 1986.[38] Duckworth's modification of the Schei ruler technique was used in this study to assess the difference in bone level around individual teeth treated for periodontal disease in subjects receiving infrequent post therapy maintenance ($\leq$ 1 time/year). Crestal bone height differences were evaluated using the initial presenting series of long cone parallel radiographs of 23 subjects with their subsequent post therapy analogous radiographic series taken 5.4±2.9 years later. Increased alveolar bone loss and tooth loss was observed in subjects examined post therapy when compared with conditions present when each subject was initially presented for periodontal treatment. It was seen that molar teeth were more at risk than incisors and cuspids and that a lack of periodontal maintenance care and inadequate plaque control contribute to progressive bone loss following treatment.

MA Listgarten et al.[45] in 1986; in his article 'Failure of a microbial assay to reliably predict disease recurrence in a treated periodontitis population receiving regularly scheduled prophylaxes'– evaluated the reliability of differential dark-field microscopy (ddfm) of subgingival bacteria to correctly predict the recurrence of periodontitis in treated patients on 2 different recall schemes. The results are based on data from 51 patients on 3-month recalls (c group) and 39 patients (t group) who received periodontal prophylaxes according to a customized regimen based on ddfm of subgingival bacterial morphotypes. No significant differences were detected in the rate of recurrence of periodontitis between the 2 groups, although the incidence of disease recurrence tended to be greater in the c group. The proportions of spirochetes and motile rods observed at base line, or the average of the values observed at base line, 3 months and 6 months, were compared between subjects with and without disease recurrences. Significantly elevated proportions of these bacterial morphotypes were observed in patients of the t group who demonstrated evidence of disease recurrence during the first year as compared to subjects without disease recurrence. No significant differences could be detected in bacterial morphotypes between patients resistant to disease recurrence and those who developed recurrences at some time during the 3-year period covered by this report. The ability of ddfm of subgingival bacterial morphotypes to predict future disease occurrence was tested for 1 and 3-year periods, in both the c and t groups. The test appears to be reliable only for subjects on the experimental maintenance regimen (group t) and for prediction of disease recurrence for the initial 1-year period. The reliability of the test to predict disease recurrence over a 3-year period fails off significantly in the t group. The test was not reliable in predicting disease recurrence in the c group, presumably because of the disrupting effect of regularly scheduled tri-monthly prophylaxes on the composition of the subgingival microbiota.

Ramfjord SP et al. in 1987[23] compared, over 5 years, the results following four conventionally used modalities of treatment for moderate to advanced periodontitis. Ninety subjects (53 females and 37 males), age 24 to 68 yr (mean 45) were selected for the study. To be included, the subjects had to have at least 20 treatable teeth, and some periodontal pockets extending at least 4.0 mm or more apically to the cementoenamel junction. Plaque, gingivitis, calculus, depth of pockets, clinical loss of attachment from the cementoenamel junction and tooth mobility was scored. All of the patients then had scaling, root planing and instructions in oral hygiene by a dental hygienist for a total of 5 to 8 hrs over about 4 weeks. A re-scoring was done 4 weeks after completion of the scaling and root planing. Then four types of periodontal treatment were provided by a periodontist. Each quadrant of the patient's dentition was assigned randomly to one of four treatment types:

1. Surgical pocket elimination or reduction, including bone surgery,
2. Modified Widman flap surgery,

3. Subgingival curettage following scaling and root planing, and
4. Scaling and root planing only.

The teeth were polished once a week for 3 to 4 weeks after the periodontal treatment. Then the patients were placed on recall prophylaxis and topical fluoride every 3 months, and scored annually prior to prophylaxis. If, at the time of the routine prophylaxis, pocket exudate could be expressed by moving a ball burnisher against the surface of the gingiva and/or overt bleeding resulted from pocket probing, the patient was rescheduled in 2 to 3 weeks for examination and possible re-treatment by a periodontist. 72 of the original 90 patients completed the 5-yr study. From the study it was concluded that:

1. Scaling and root planing alone was as effective in maintenance of clinical periodontal attachment as curettage for pockets less than or equal to 6 mm and preferable to other surgical modalities of the treatment.
2. For pockets greater than 7 mm, the attachment results were similar for the four methods.
3. Selective re-treatment during the maintenance phase appears to be desirable.

Thomas G. Wilson Jr[43] in his article Compliance– A review of the literature with possible applications to periodontics, 1987 has discussed about the medical literature which says that patients with chronic illnesses tend to comply poorly, especially if the disease is not perceived by the patient as particularly threatening whereas the dental literature covers two principal areas: compliance with oral hygiene regimens and utilization of dental care by the public. These works show that most patients surveyed do not clean their teeth as they have been instructed, and most do not receive routine dental care. The reasons for this non-compliance are highly variable but include lack of pertinent information, fear, economics, and the patient's perception of lack of compassion on the part of the dental therapist. In periodontics the majority of studies have focused on the effectiveness of patient oral hygiene along with its modification and on maintenance therapy. Other work in the periodontal literature is discussed in light of the widespread non-compliance shown by our patients. A number of studies have been undertaken on how best to improve compliance. In general, it has been found that patients comply better when they are informed and positively reinforced, and when barriers to treatment are reduced. Suggestions are made for improving compliance in the periodontal office and for tailoring therapy to predicted compliance levels.

In a study conducted by Thomas G. Wilson, Jr., Mark E. Glover, Arvinder K. Malik, Janice A. Schoen, and Dovalee Dorsett in 1987,[37] where a group of 162 maintenance patients, were surveyed for tooth loss over a 5-year period. The group was divided into those who complied to suggested maintenance schedules and those whose compliance was erratic. It was found that none of the patients who had complied to suggested maintenance schedules lost any teeth. In the erratic group, where all tooth loss occurred, it was found that the more often a patient presented for maintenance, the less likely he was to lose teeth.

Wayne B. Kaldahl, Kenneth L. Kalkwarf, Kashinath D. Patil, Jack K. Dyer and Robert E. Bates in 1988[35] conducted a study on 82 periodontally involved patients who were treated in a split mouth design such that one quadrant received coronal scaling (CS), root planing (RP), modified Widman surgery (MW), and flap with osseous resection surgery (FO). The therapy was performed in three phases: Phase I: the teeth previously designated to receive RP, MW, and FO were thoroughly root planed and the teeth designated to receive CS were scaled with no subgingival instrumentation, plaque control was initiated and reinforced for the entire mouth; Phase II: the designated teeth received MW or FO surgery; and Phase III: maintenance therapy every three months. The CS teeth received coronal scaling and polishing during maintenance appointments, while RP, MW, and FO teeth received supragingival instrumentation, subgingival instrumentation and polishing. Clinical measurements were taken initially, four weeks post-Phase I, 10 weeks post-Phase II, and after each of 2 years of maintenance care. All therapy modalities resulted in a decrease of mean probing depth with the FO producing the greatest decrease followed by MW, RP, and CS. The deeper the initial probing depth, the greater was the mean reduction of probing depth. FO created a loss of mean probing attachment in the 1 to 4 mm category. RP and MW produced the greatest gain of mean probing attachment in the 5 to 6 mm category. RP, MW, and FO produced similar gains in the $\geq$ 7 mm category. FO created the most gingival recession followed by MW, RP, and CS.

In a study done by Listgarten[44] in 1991, a total of 98 adults previously treated for moderate to advanced periodontitis and on a 3-month recall schedule were screened for the presence of critical levels of Actinobacillus actinomycetemcomitans, Prevotella (Bacteroides) intermedia, and Porphyromonas (Bacteroides) gingivalis. Patients with at least 2 positive sites were placed in a positive group and patients without or with low levels of these bacteria in a negative group. During the 30-month study the incidence of disease recurrence was greater in the positive group, but did not reach statistical significance. Positive patients with deeper pockets tended to be at greater risk of developing recurrent disease than those with shallower pockets. In the positive group only, both A. actinomycetemcomitans recovery and antibody levels to A. actinomycetemcomitans strain NCTC 9710 (serotype c) were inversely correlated with disease recurrence. The presence of A. actinomycetemcomitans and P. Intermedia above critical levels did not reliably predict future episodes of disease recurrence in this population. The sparse recovery of P. gingivalis did not permit us to assess its diagnostic value. With the exception of P. gingivalis, for which insufficient data were available, the results indicate that the presence or absence of the above bacterial species cannot of itself serve as a reliable predictor of future episodes of recurrent disease in a population of treated patients on a regular 3-month recall schedule.

Anthony R. Mendoza, Guy M. Newcomb, And Kenneth C. Nixon[10] in 1991 conducted a study on patients who were under periodontal maintenance after treatment

in a specialist periodontal practice from 1983 to 1986. Based on their compliance with the recommended schedule of visits, the patients were classified as either compliant or non-compliant. The results indicated that there were no significant differences between compliant and non-compliant patients with regards to age, sex, number of missing teeth, plaque score, or periodontal disease severity. More non-compliant patients than compliant patients were smokers. By contrast, more compliant patients were covered by private dental insurance and more had periodontal surgery during treatment. Only 36% of the initial patient sample was found to be compliant at the end of 1989. Non-compliant patients were sent a questionnaire seeking reasons for their non-compliance. 40% of the questionnaires were returned. The most common reason given for non-compliance was that a general dental practitioner was attending to the patient's periodontal treatment needs. Many considered supportive periodontal therapy to be too expensive, while a significant proportion considered that they no longer required treatment. The results suggests that embarrassment, nervousness, lack of time, practice location, beliefs/ideals, and personal crises were not significant reasons for non-compliance.

In 1994, Pierpaolo Cortellini, Giovanpaolo Pini-Prato, Maurizio Tonetti[7] had done an investigation to assess the role of supportive periodontal care in the maintenance of clinical attachment gained, after surgical treatment according to the principles of GTR, in deep infrabony defects. Following GTR treatment, 40 deep infrabony defects in 23 patients gained 4.1 mm of probing attachment level (PAL) after 1 year of stringent plaque control. In the subsequent 3 years, 15 patients (22 sites, group A) were recalled every 3 months. In this group, the gained attachment level remained stable. Conversely, 8 patients (18 sites, group B), who received only sporadic care, lost at 4 years, 2.8±2.7 mm of the PAL gained at 1 year. Group A patients had significantly lower full mouth plaque and bleeding scores than group B at 4 years. Furthermore, detection of bleeding on probing, plaque, P. gingivalis and P. intermedia was significantly more frequent in regenerated sites of group B patients. Risk assessment analysis indicated that GTR sites in patients receiving only sporadic care had a 50-fold increase in risk of PAL loss between 1 and 4 years with respect to patients undergoing regular recall. It was concluded that stability of gained clinical attachment was dependent upon stringent oral hygiene.

N. Demetriou, A. Tsami-Pandi, and A. Parashis[8] in 1995 conducted a study to determine the degree of compliance with supportive periodontal treatment (SPT) recommended in private periodontal practice and to determine if any significant differences existed in the characteristics of compliant, non-compliant, and erratically compliant patients. The study covered a period of 14 years (1977 to 1991) and included 521 patients who were classified by sex, age, socio-economic class, disease severity, treatment rendered, and the year maintenance began. Compliance was categorized into four groups: complete compliance, erratic compliance, patients who discontinued SPT and patients who never presented for SPT. Females began SPT more often than

males. Only 27.4% of the patients were in complete compliance at the end of the study. A significantly greater percentage of females and patients who had been treated by only scaling and root planing were in complete compliance. Younger patients who had received only scaling and root planing, and individuals in socio-economic class had a significantly lower tendency to drop out. The results confirm that compliance to SPT in private periodontal practice is far from ideal.

Luigi Checchi, Marco Montevecchi, Maria Rosaria Antonella Gatto, Leonardo Trombelli[6] in the year 2002, conducted a retrospective study where the efficacy of periodontal therapy and maintenance in preventing tooth loss was evaluated. The study included 92 patients with 2310 teeth diagnosed with chronic adult periodontitis, observed over a mean period of 6.7 years, with each patient receiving surgical therapy in two or more quadrants. The group was divided into two subgroups: those who complied with the recommended maintenance schedule and those whose compliance was erratic. Individual tooth prognosis was assigned according to radiographic parameters. At the completion of active periodontal therapy, 2184 teeth were present. During the maintenance period, 44 teeth were lost due to periodontal reasons. Tooth mortality revealed a mean annual adjusted tooth loss rate of 0.07/year. Molars were the teeth most frequently lost; canines the least. The number of teeth lost in the three prognostic categories was: one (0.07%) for teeth with good prognoses, 21 (3.63%) for questionable prognoses and 22 (11.34%) for hopeless prognoses. Patients complying erratically with supportive periodontal therapy were at a 5.6 times greater risk for tooth loss following active therapy than regularly compliant patients. The results demonstrated a low tooth mortality rate in periodontal patients following active treatment combined with a strict maintenance program.

Periodontal Treatment Without Maintenance

A clinical trial was undertaken by Rosling B et al.[50] in 1976 to test the hypothesis that periodontitis can be cured and that bone regeneration occurs in infrabony pockets in patients maintained on an optimal standard of oral hygiene. The material comprised 24 patients with advanced periodontal disease. After an initial examination, the patients were randomly distributed into one test group and one control group. All the patients were given instructions and practice in a proper oral hygiene technique, and then subjected to periodontal surgery using the modified Widman flap procedure. Following treatment, during a 2-year period the patients of the test group were recalled once every second week for professional tooth cleaning. The control patients were recalled once every 12 months for prophylaxis. The results showed that all osseous defects of the patients of the test group were refilled with bone. The control patients, on the other hand, could not maintain a high standard of oral hygiene, and exhibited a progressive deterioration of the periodontal tissues during the post-surgical observation time.

Hamp et al. 1975,[46] in his article had done a 5-year post-operative evaluation of 100 patients treated for periodontal breakdown in the bi/tri-furcation areas. The results

of this study demonstrate that it is possible to arrest further destruction within the root furcation area. The successful treatment of the multi-rooted teeth was probably the consequence of:

1. The quasi total elimination of plaque retention areas from the bi/tri-furcation area, and
2. Meticulous oral hygiene by the patients.

According to R.W.Hill[48] et al, 1981 in his article, he had discussed about the results of various modalities of periodontal therapy studied in 90 subjects (mean age 45 years) with moderate to severe periodontitis. Initial measurements of pocket depth and clinical attachment levels were compared with measurements obtained after the initial hygienic phase of the treatment and measurements of the same areas 1 and 2 years after four different types of periodontal treatment had been applied on a randomized basis to each of the four quadrants of the dentition. These treatments were:

1. Surgical pocket elimination or reduction,
2. Modified Widman flap surgery,
3. Subgingival curettage,
4. Scaling and root planing only.

The patients were recalled for prophylaxis every 3 months, and re-scored annually. One way analysis of variance and Scheffe's method were used to test the hypothesis of equal treatment effects. The results were analysed both with initial pocket depth as the baseline and with pocket depth at the hygienic phase as the baseline using a grouping of pockets 1 to 3 mm, 4 to 6 mm, and ≥ 7 mm. For the 1 to 3 mm pockets there was a slight reduction in depth at the hygienic phase, with only minor changes after the various modalities of treatment over 2 years. However, significant losses of attachment after all modalities of periodontal therapy, including scaling alone, were observed at both the 1-year and 2-year intervals. For pockets 4 to 6 mm deep, the main reduction in pocket depth occurred at the hygienic phase, but the pockets also were reduced by further treatment, most by pocket elimination and modified Widman surgery. However, this reduction in pocket depth after surgery had no beneficial influence on maintenance of the attachment level, which actually was maintained best by scaling alone. For deep pockets ≥ 7 mm, significant reduction in pocket depth occurred both at the hygienic phase and 1 to 2 years after treatment, with the greatest initial reduction after pocket elimination surgery. However, again there was no significant difference in attachment results among the four methods.

The purpose of the study by Philstrom et al.[49] in 1981 was to compare the long term effectiveness of scaling and root planing alone to scaling and root planing followed by periodontal surgery. 17 subjects with moderate to advanced periodontitis received thorough scaling and root planing as well as oral hygiene instructions. A modified Widman flap was then randomly performed for one-half of each subject's dentition. Recall prophylaxis and oral hygiene reinforcement were administered for 4 years after completion of therapy. Shallow crevices (1-3 mm) subjected to either procedure

tended to increase slightly in depth and exhibit a slight loss of attachment when compared to pre-treatment measurements. Moderately deep pockets (4-6 mm) treated by either procedure were reduced and demonstrated a sustained gain or maintenance of attachment level. Pockets initially ≥ 7 mm exhibited the greatest reduction in depth and attachment gain. Gingivitis was reduced following either procedure for moderate and deep pockets. No difference in supragingival plaque retention was noted and both procedures reduced calculus. The results indicate that both procedures were effective in treating moderate to advanced periodontitis. However, the additional flap procedure tended to result in greater pocket reduction and attachment gain for deeper pockets.

In a study done by Walter T et al.[53] in 1982, 100 patients with periodontal disease who had been treated and maintained for 15 years or longer was studied for tooth loss. The patients averaged 43.8 years of age and consisted of 59 females and 41 males. Patients were examined and their dental records were reviewed. On the basis of response to therapy and tooth loss, the patients were classified as Well-Maintained (77), Downhill (15), or Extreme Downhill (8). At the completion of initial treatment, 2,627 teeth were present. Of this number, during the maintenance period, 259 teeth (9.8%) were lost due to periodontal disease, while 40 teeth (1.5%) were lost due to other causes. Evaluation was made as to patterns of tooth loss, loss of questionable teeth, loss of teeth with furcations, surgical vs. non-surgical therapy, and presence of fixed or removable prostheses. Considerable variation occurred between response groups. Periodontal disease appears to be bilaterally symmetrical and tooth loss emulated this pattern with greatest loss of maxillary second molars and least loss of mandibular cuspids.

A clinical trial was undertaken by Lindhe J et al.[55] in 1982 to study the effect of one surgical and one non-surgical treatment modality in patients with advanced periodontal disease. 15 patients were selected for the study. Following a baseline examination comprising assessments of oral hygiene status, gingival conditions, probing depths and attachment levels, all participants were subjected to treatment. In each patient, scaling and root planing were carried out in conjunction with the modified Widman flap procedure in two jaw quadrants while in the contralateral quadrants the treatment was restricted to scaling and root planing. During the phase of active treatment, i.e. the period between the first and last operation, and for the subsequent 6 months of healing, the patients were subjected to "professional tooth cleaning" once every 2 weeks. From this time until the end of the trial which was 24 months after active treatment, the patients were recalled for prophylaxis once every 3 months. Re-examinations were performed 6, 12 and 24 months after the completion of active treatment. The results demonstrated that scaling and root planing used alone were almost equally effective as their use in combination with the modified Widman flap procedure in establishing clinically healthy gingiva and in preventing further loss of attachment. Both treatment modalities prevented recurrence of periodontal disease for the 24 months of observation. The analysis of the probing depth data revealed that

both methods of treatment resulted in a high frequency of probing depths of < 4 mm. The probing depth reduction was more pronounced in initially deep than in initially shallow pockets and, for initially deep pockets, more marked in sites subjected to surgery than in sites exposed to scaling and root planing alone. The measurements also showed that sites with initially deep pockets exhibited more pronounced gain of clinical attachment than sites with initially shallow pockets. Significant loss of attachment did not occur in sites treated with scaling and root planing alone while attachment loss was found following Widman flap surgery in sites with initial probing depth of < 4 mm.

Maintenance After Periodontal Treatment

In 1978, Axelsson and Lindhe[29] described a maintenance care program which involved prophylaxis once every 2-3 months. The plaque control program described appeared to be effective not only against the recurrence of periodontitis– in patients not subjected to periodontal surgery– but also against caries.

J.W. Knowles et al. in 1979[21] conducted a study where patients were included in a 5-year follow-up in 1975. 78 patients who had completed at least the first 1-year recall and scoring were included in the study. They had a total of 1974 teeth (an average of approximately 25 teeth). At the 5-year post-operative recall there were 72 patients, and at 6th year, 64. However, this number fell off to 43 patients with 1038 teeth after 8 years indicating that it becomes difficult to extend a longitudinal study with regimented recall beyond 5 years of follow-up.

Sture Nyman, Jan Lindhe, Bengt Rosling in 1977[39] conducted a clinical trial to study the results of periodontal treatment following different modes of periodontal surgery in patients not recalled for maintenance care. The material consisted of 25 patients distributed into 5 groups. Following an initial examination, all patients underwent pre-surgical treatment including case presentation and instruction in oral hygiene measures. This instruction was given once. The various patient groups were then subjected to one of the following surgical procedures:

1. The apically repositioned flap operation including elimination of bony defects.
2. The apically repositioned flap operation including curettage of bony defects but without removal of bone.
3. The “Widman flap” technique including elimination of bony defects.
4. The “Widman flap” technique including curettage of bony defects but without removal of bone.
5. Gingivectomy including curettage of bony defects but without removal of bone.

6, 12 and 24 months after completion of the treatment, the patients were recalled for assessment of their oral hygiene standard and periodontal conditions. The results showed that case presentation and oral hygiene instruction given once, only temporarily improved the patient's oral hygiene habits. Renewed accumulation of plaque in the operated areas resulted in recurrence of periodontal disease including a significant

further loss of attachment. All 5 different techniques for surgical pocket elimination were equally ineffective in preventing recurrence of destructive periodontitis.

Store Nyman, Bengt Rosling, Jan Lindhe in 1985[27] had done an investigation to find out whether favourable conditions for healing after periodontal surgery would develop in patients whose oral hygiene was professionally maintained at a high standard. The study was performed on 20 patients with advanced periodontal disease. Following an initial examination, comprising plaque index and gingival index scoring, measurement of pocket depths and loss of attachment, the patients were randomly distributed between a test and a control group. The patients first received detailed instructions for oral hygiene and were then subjected to periodontal surgery with the reverse bevel flap procedure. After surgery, the patients of the test group received professional cleaning of the teeth once every 2 weeks. The patients of the control group were recalled for scaling of the teeth once every 6 months. All patients were re-examined after 6, 12 and 24 months. It was found that the control patients were unable to maintain a high standard of oral hygiene with the result that the treatment of the periodontal disease failed. The patients of the test group maintained a high standard of oral hygiene, and the treatment of the periodontal disease was, therefore, successful.

Optimal Frequency of Supportive Periodontal Care

J Caton et al.[62] in 1982 evaluated the clinical stability of healed periodontal pockets over a 3-month time period to determine whether this time interval is appropriate for periodontal maintenance therapy. The clinical characteristics of 128 pockets (3-7 mm depth) distributed in 10 patients, were monitored immediately before and 4, 8 and 16 weeks after a single episode of subgingival root planing. The clinical parameters measured were: pocket depth and bleeding after probing with 15, 25 and 50 gm and manual probing, gingival margin location, clinical attachment level, and gingival and plaque indices. Oral hygiene instruction and supragingival cleaning were given at each time point. An average aggregated score for each subject and for each parameter was calculated at each time point. A repeated measure all within analysis of variance was done, and the Tukey multiple range test was used to assess the significance of differences among and between the means. The significant decreases in plaque, gingival and bleeding indices, and pocket depth as well as the significant gingival recession and gain of clinical attachment which were present at the 4 week point were maintained at 8 and 16 weeks after root planing. It was concluded that the favourable clinical changes which occur in periodontal pockets within 1-month after a single episode of subgingival root planing combined with improved oral hygiene can be maintained for an additional 3-month time period.

16 advanced periodontitis patients were subjected to initial periodontal treatment and monitored every 3rd month during 42 months in a study done by Noel Claffey et al.[63] Clinical characteristics at baseline and during the 42-month maintenance period were investigated for their association with probing attachment loss over the 42-month

period, both on a patient level and on a site level. On a patient level, averaged full-mouth plaque and bleeding on probing scores over the maintenance interval showed little association with probing attachment loss. Little association was also observed for % sites with depth ≥ 6 mm at baseline. However, a notable relationship was seen for % sites ≥ 6 mm at 3 months. This finding initiated a separation of the 16 subjects into 2 groups based upon % sites ≥ 6 mm at 3 months (groups' high 'and' low'). Site level analyses for these groups showed little association between frequent presence of plaque at the sites over the maintenance interval and probing attachment loss. Frequent bleeding on probing showed limited relationship with attachment loss for group 'low', but an appreciable association for group 'high". The findings suggest that advanced periodontitis patients with multiple residual probing depths a 6 mm at re-evaluation run a greater risk of developing sites with additional attachment loss than patients with few such residual depths. For such higher risk patients, bleeding on probing at maintenance examinations may be a useful indicator of subsequent deterioration at a site level.

In a study done by Badersten A[60] et al. in 1987, a total of 2214 sites from incisors, cuspids, and premolars were studied in 46 adult periodontitis patients following treatment consisting of plaque control and root debridement. The periodontal status at 24 months was used as baseline for observations during the subsequent 24-48 month interval which included 4 recall visits for debridement at the 24, 30, 36, and 42-month time points. The data were analysed for pooled groups of sites of different probing depth at 24 months: ≤ 3.5 mm, 4.0-6.5 mm. and ≥ 7.0 mm. The results showed little change during the 24-48 month interval in mean scores for bleeding on probing, probing depth, and probing attachment level for all 3 groups of sites. Individual sites with probing attachment loss during the 24-48 month period were identified. The frequency of such sites was similar, irrespective of 24-month probing depth. The sites identified with probing attachment loss during the 24-48 month interval generally differed in location from those identified as having probing attachment loss during the proceeding 0-24 month period. Often, the loss of probing attachment during the 24-48 month interval seemed to be a reversal of a prior gain in probing attachment during the 0-24 month interval. This study in non-molar teeth of subjects with generally good level of compliance failed to demonstrate that sites with deeper probing depth were more difficult to maintain than shallower sites.

Intraosseous, periodontal defects in 12 subjects initially treated by root planing alone (21 defects) or by flap surgery (21 defects) were monitored during a 5-year post-operative interval by S Renvert et al.[78] in 1990. Maintenance therapy during this interval was limited to reinforcement of oral hygiene and tooth polishing every 6 months. No subgingival instrumentation was performed at the defect sites. Longitudinal clinical measurements demonstrated that surgically treated lesions responded with somewhat more reduction of probing depth and more gain of probing bone level than root-planed lesions. Mean gains of probing attachment level were similar for the 2 treatments.

Some relapse of the clinical conditions could be observed towards the end of the 5-year observation interval compared to the results at year 1 and year 2. However, the majority of defects subjected to either treatment showed 60-month recordings of probing attachment and probing bone levels equal to or slightly improved compared to those at baseline. Counts from cultures of subgingival, microbial samples were obtained at 42, 48 and 60 months. No significant difference between the 2 therapies was observed for the investigated groups of microorganisms.

In a study done by Lindhe J et al.[77] in 1991, a total of 375 adult subjects were recruited for a clinical trial aimed at assessing the effect of a preventive program, based on plaque control and topical application of fluoride, on the incidence of caries and periodontal disease. After a baseline examination, the volunteers were subjected to scaling, root-planing and conventional caries therapy. During the course of the subsequent 6 years, they were recalled for preventive measures once every 2-3 months. After the 6-year follow-up examination, however, it was decided to extend the interval between the preventive sessions. Thus, during the next 9-year period, about 95% of the participants returned for preventive measures only 1 to 2 times per year. A small subgroup of about 15 subjects, who, during the initial 6 years had developed new caries lesions or had exhibited additional periodontal attachment loss, however, were also during the following 9 years recalled 3-6 times per year for oral hygiene control and preventive therapy. The re-examination performed in 1987 disclosed that the 317 subjects, who participated during the entire 15-year period, had a low incidence of caries and almost no further loss of periodontal tissue support. It was suggested that improved self performed oral hygiene, daily use of fluoridated dentifrice and regularly repeated professional tooth cleaning effectively prevented recurrence of dental disease.

In a study by Wayne B. Kaldahl et al.[65] in 1996, 74 patients with moderate to advanced periodontitis were classified by cigarette consumption at the initial exam: heavy smokers (HS) $\geq$ 20 cigarettes/day (n=31); light smokers (LS) $\leq$ 19 cigarettes/day (n=15); past smokers (PS) had a history of smoking but had quit by the initial exam (n=10); and non-smokers (NS) had never smoked (n=18). All patients were treated with four modalities of periodontal therapy followed by supportive periodontal treatment (SPT) for a period of up to 7 years. Clinical parameters including probing depth (PD), clinical attachment level (CAL), recession (REC), presence of bleeding on probing (BOP), and supragingival plaque (PL) were assessed at six sites around each tooth. Horizontal probing attachment level (HAL) was obtained at molar furcation sites. Data were collected initially, 4 weeks after non-surgical therapy, 10 weeks after surgical therapy, and yearly during SPT. HS and LS demonstrated less PD reduction and less CAL gain than PS and NS following active treatment and throughout SPT. Following active treatment, HAL changes were similar for all groups, but during 7 years of SPT, HS and LS experienced greater loss of HAL. There were no differences in BOP among the four groups. HS demonstrated a higher percentage of PL positive sites compared

to the other groups. In summary, HS and LS responded less favourably to therapy than PS and NS. A past history of smoking was not deleterious to the response to therapy.

In an another study done by Wayne B. Kaldahl et al.[66] in 1996, 82 periodontal patients were treated in a split mouth design with coronal scaling (CS), root planing (RP), modified Widman surgery (MW), and flap with osseous resection surgery (FO) which was randomly assigned to various quadrants in the dentition. Therapy was performed in 3 phases: non-surgical, surgical, and supportive periodontal treatment (SPT) ≤ 7 years. Clinical data consisted of probing depth (PD), clinical attachment level (CAL), gingival recession (REC), bleeding on probing (BOP), suppuration (SUP), and supragingival plaque (PL). Because of the necessity to exit many CS treated sites due to breakdown, data for CS were reported only up to 2 years. All therapies produced mean PD reduction with FO > MW > RP > CS following the surgical phase for all probing depth severities. By the end of year 2 there were no differences between the therapies in the 1 to 4 mm sites. There were no differences in PD reduction between MW and RP treated sites by the end of year 3 in the 5 to 6 mm sites and by the end of year 5 in the ≥ 7 mm sites. FO produced greater PD reduction in ≥ 5 mm sites through year 7 of SPT. Following the surgical phase, FO produced a mean CAL loss and CS and RP produced a slight gain in 1-4 mm sites. RP and MW produced a greater gain of CAL than CS and FO following the surgical phase in 5 to 6 mm sites, but the magnitude of difference decreased during SPT. Similar CAL gains were produced by RP, MW, and FO in sites ≥ 7 mm. These gains were greater than that produced by CS and were sustained during SPT. Recession was produced with FO > MW > RP > CS. This relationship was maintained throughout SPT. The prevalence of BOP, SUP, and PL were greatly reduced throughout the study and were comparable between sites treated by RP, MW, and FO while the CS sites had more BOP and SUP.

Walter J L et al.[67] in 2002 did a study to determine how long the surgery-sparing benefits of less invasive treatment would persist. 90 patients were scheduled for maintenance therapy at 3-month intervals over a 5-year period. They were evaluated periodically for surgical needs by a clinician who was not aware of the non-surgical periodontal treatment the patient had received. The initial treatment benefits were sustained, as the number of teeth needing periodontal surgery or extraction was 0.06 teeth per patient after 1.1 year, 0.22 after 2.3 years, 0.51 after 3.6 years and 0.86 after 5.1 years. A non-invasive treatment regimen for an anaerobic infection in teeth seriously compromised by periodontal disease resulted in a reduced need for surgery or tooth extraction for at least 5 years after completion of the initial treatment.

Limited information is available comparing the relative longitudinal effectiveness with respect to tooth type of scaling and root planing alone and scaling and root planing followed by flap procedures. The purpose of the study done by Pihlstrom B et al.[68] was to investigate these treatment methods as applied to molar and non-molar teeth on a longitudinal basis in humans. 17 subjects with chronic periodontitis received thorough scaling and root planing as well as oral hygiene instruction. A modified Widman flap

was then randomly performed for one-half of each subject's dentition. Routine recall prophylaxis and oral hygiene reinforcement were administered post-surgically every 3 to 4 months. Pocket depth and clinical attachment levels were recorded by a single calibrated examiner before therapy and at intervals up to 6½ years following active treatment. Ten subjects remained as participants after 6½ years. A paired t test was used to test for the mean difference in pocket depth and clinical attachment level between molar and non-molar teeth for each treatment method. For pockets initially 4 to 6 mm, the results indicated greater pocket depth and more apical clinical attachment level on molars than non-molars treated by either method of therapy. For pockets initially ≥ 7 mm there was no difference between pocket depth on molar and non-molar teeth following scaling and root planing alone. However, there was less overall pocket depth on non-molars than molars following the flap procedure, indicating a greater effect of pocket reduction on non-molar than molar teeth with the flap procedure. No difference between tooth types was found for clinical attachment level in pockets initially > 7 mm with either treatment method. Both treatment methods resulted in at least maintenance of pre-treatment attachment levels adjacent to molar and non-molar teeth.

In a study done by P Ramberg et al.[69] in 2001, both the short and the long-term effects were evaluated of a treatment that, during the phase of basic therapy, included administration of systemic tetracycline and non-surgical intervention. 35 adult human subjects with advanced periodontitis, 19 females and 16 males, aged between 24 and 60 years, were included in a test group. 80 age and sex-matched adult periodontitis subjects were recruited for a control group (42 females and 38 males). A baseline examination included assessment of the following parameters: number of teeth, plaque, bleeding on probing, probing attachment level, probing pocket depth. In radiographs, the distance between the cementoenamel junction and the alveolar bone crest was determined at all interproximal sites. The subjects were given oral hygiene instruction. The members of the test group were provided with tablets with 250 mg of tetracycline hydrochloride and were instructed to take 1 tablet 4x per day for a period of 3 weeks. No antibiotic was given to the subjects in the control group. During the 3-week interval, all participants received 4-6 sessions of non-surgical periodontal therapy. All subjects were subsequently enrolled in a maintenance care program and were provided with supportive periodontal therapy (SPT) 3-4x per year. Clinical re-examinations were performed after 1, 3, 5 and 13 years. This investigation demonstrated that tetracycline administered during a 3-week period concomitant with non-surgical treatment enhanced the outcome of mechanical therapy.

At the re-examination 1 year after active therapy, there was in the test group an average gain in probing attachment that was almost 3x higher than the gain that occurred in an age and sex-matched control group. Re-examinations after 3, 5, and 13 years of SPT disclosed that this short-term benefit was not maintained in the longer perspective. The beneficial effect of systemically administered tetracycline on probing attachment level occurred in the first year post-therapy. Annual rates of probing attachment level change from 1 to 13 years did not differ between groups.

A prospective study was designed by William Jenkins et al.[64] in 2000 who investigated the role of root debridement at 3-month intervals for patients with periodontitis whose disease had persisted following the completion of conventional periodontal treatment. 39 maintenance patients with at least 4 pockets at least 4 mm deep were assigned to coronal scaling (CS) and subgingival scaling (SS) groups. Probing depths (PD), bleeding on probing (BOP) and relative attachment levels (RAL) were recorded at all eligible sites at baseline and 3, 6, 9 and 12 months later. Plaque index scores were recorded at the 12-month visit. At every visit, following data collection, both groups received a coronal scaling and the SS group, in addition, received a thorough subgingival debridement. In the CS group, subgingival debridement was performed only for 'loser' sites which exhibited loss of attachment 2 mm relative to baseline values. Due to low compliance, only 31 patients completed the study. Thus, data analyses were carried out for 130 sites in 17 CS group patients and 146 sites in 14 SS group patients. During the course of the study, 21 loser sites were identified in each group, but the difference in proportion of loser sites between groups was not significant. Furthermore, although there was a trend toward PD reduction in both groups throughout the study, mean PD, RAL and BOP values were not significantly different from baseline values at any time point, and there were no significant differences between groups with respect to these variables. Mean plaque scores measured at the 12-month visit revealed no significant differences between groups. These findings call into question the value of performing repeated subgingival scaling at 3-month intervals for patients with persistent disease.

The aim of the study done by B Rosling et al.[70] in 2001 was to evaluate disease progression during supportive periodontal therapy in (i) a group of 225 subjects with "normal" (NG) and (ii) a group with high susceptibility (HSG; n=109) to periodontal disease (based on their baseline disease status). The following variables were recorded at the baseline examination (1 year after they received non-surgical periodontal therapy) and at the re-examination after 12 years of maintenance: number of teeth, plaque, probing pocket depth, probing attachment level, bone level in full mouth radiographs. Supportive periodontal therapy was delivered 3-4x per year and included repeated oral hygiene instructions and debridement. In addition, sites that bled on probing and had a PPD value of 5 mm received subgingival instrumentation. A comparison between the findings at baseline and after 12 years revealed that in the NG, most subjects maintained their periodontal condition unchanged during the maintenance period; only a few subjects experienced tooth loss and the figures describing the mean amount of bone and attachment loss were small (0.5 mm and 0.3 mm respectively). The HSG patients experienced some tooth loss and also lost significant amounts of bone and attachment during the 12 years of SPT. Thus, in this group of subjects, the mean overall PAL loss amounted to 0.8 mm i.e. 0.06 mm/tooth surface/year. In the NG, the overall attachment loss was significantly smaller: 0.5 mm i.e. 0.04 mm/tooth surface/year. In subjects with a high susceptibility for periodontal disease who had been treated for this

condition by non-surgical means, an SPT program including regularly repeated oral hygiene instruction and subgingival debridement, made it possible to maintain bone and attachment levels at a reasonably stable level over a 12-year period. A similar SPT provided to a group of subjects with normal susceptibility to periodontal disease, on the other hand, prevented almost entirely major tooth, bone and attachment loss.

A study was done by William Becker et al.[61] in 2001 to compare, longitudinally, the effectiveness of scaling and root planing, osseous surgery, and the modified Widman procedures. The study was carried out in a private practice setting. 16 adult patients with moderate to advanced adult periodontitis were treated with initial scaling and oral hygiene procedures. Post hygiene data were used for comparison of changes in probing depth, clinical attachment levels and gingival recession. The initial examination data were used to compare changes in plaque and gingival indices. Frequency distributions were used to compare changes that occurred at individual sites. At one year, plaque and gingival indices were significantly reduced when compared with the initial examination. At one year, shallow pockets (1-3 mm) were reduced when compared to post-hygiene. 4 to 6 mm pockets were significantly reduced by the three procedures. Osseous surgery and modified Widman had significantly greater pocket reduction when compared with scaling. For pockets > 7 mm, osseous surgery and the modified Widman had significantly greater reduction when compared with scaling. For pockets 1-3 mm at one year osseous surgery had significantly greater clinical attachment loss when compared with scaling. For 4-6 mm pockets at one year, the three procedures had slight gains in clinical attachment levels. The results were similar for pockets with > 7 mm.

Interproximal soft tissue craters were measured for six postoperative weeks. Initially, the modified Widman had a higher percentage of soft tissue craters when compared with osseous surgery. At six weeks, however, there were no significant differences when the surgical procedures were compared. Recession was measured at each examination. Recession for 1-3 mm pockets at one year was greater for osseous surgery when compared with scaling and the modified Widman. Recession for 4-6 mm and > 7 pockets was greater for the surgical procedures than scaling. The results from this study indicate that with 3-month maintenance recalls, both the modified Widman and osseous surgery are effective for pocket reduction, and each will produce a slight gain of clinical attachment over 1 year. Scaling was effective at maintaining attachment levels but was not as effective in reducing pocket depth.

Compliance and its Role in Periodontal Therapy

The role of personal plaque control in periodontal maintenance care was studied in 78 patients who had undergone periodontal therapy and were on 3-month recall for prophylaxis over 8 years.[81] Variations in pocket depth and attachment levels were related to individuals with plaque scores above and below the median. The results also were analysed by comparing the 25% of the sample having the lowest plaque scores

with the 25% having the highest scores over 7 years of maintenance care. Students t test was used. It was found that personal oral hygiene as expressed in plaque scores was not critical for maintenance of post-treatment pocket depth and attachment levels in patients with professional tooth cleaning every 3 months. The initial post-treatment reductions in pocket depth and variations in attachment levels were more favourable in patients with good than with poor oral hygiene, but, these differences were not significant after 3 to 4 years of maintenance care.

The purpose of the study by Glavind L et al.[82] was to examine the effect on oral hygiene and gingival health of plaque scoring and the performance of a "tooth brushing test" at each visit during initial periodontal treatment, A total of 63 adult periodontal patients (22-67 years of age) was allocated to 4 matched groups: Brushing test group (B), open scoring group (O), minimal feedback group (M) and control group (C). The oral hygiene instruction for groups B, O and M was provided by handing out a self-educational manual on oral home care, while the patients of control group (C) received a short brochure describing the bass brushing technique and the use of toothpicks. Feedback on the improvement of oral hygiene performance was delivered to groups B and O by scoring of plaque and gingival bleeding by probing while this feedback was avoided in the 2 other groups (M, C). The patients of group B performed a tooth brushing test at each of 3 visits. After 3 months the plaque scores of groups B (27%) and O (22%) had improved more than those of the 2 other groups (35%). However, the improvement in gingival bleeding scores was similar in all 4 groups (from 55% initially to 17% at 3 months). At later examinations only minor differences in plaque and gingival bleeding scores were recorded between the various groups. The findings show that, irrespective of the mode of instruction, a considerable improvement occurs and that this improvement is not related to open scoring of plaque or the tooth brushing test.

A study done by Iwata B et al.[85] examined the effects of reinforcement on compliance with an oral hygiene education program. Patients, 18 years of age or older who enrolled in an ongoing program at a periodontal practice received 3-5 sessions of instruction in preventive dental care. Using a between-subjects design, patients who entered the program during alternating months also had a portion of their fees refunded contingent upon improvements in their dental plaque scores. Pre and post-treatment data showed that all subjects exhibited lower plaque levels following the program, but that greater improvements were seen in patients who were exposed to the fee reduction contingency. Plaque scores taken at a 6-month follow-up revealed some relapse for the fee reduction subjects. However, their scores were still substantially better than pre-treatment, and better than those of the education only subjects, whose data differed little from untreated controls.

The Dental Professionals' Role in Supportive Periodontal Therapy

A study was done by M.A. Listgarten et al.[95] in 1981, to monitor the composition of the subgingival microflora in a group of chronic periodontitis-susceptible subjects

and to determine whether microbial changes precede or follow detectable deterioration of their clinical status, and also to determine if certain clinical or microbiological measurements can predict susceptibility to future periodontal breakdown. 20 subjects previously treated for moderate to advanced chronic periodontitis were recruited from clinic patients receiving regular maintenance care. After obtaining their informed consent, a baseline examination was carried out of all vestibular, oral and mesial dental surfaces to record gingival index (GI), plaque index (PI), probing depth (PD) and recession (RD). A pooled subgingival microbial sample was obtained with a curette from the surface with the greatest PD in each jaw sextant. After dispersion, the proportion of coccoid cells, motile rods and spirochetes was determined by dark field microscopy. All subjects then received a prophylaxis. Professional oral prophylaxis was suspended for 1 year, but the subjects returned to the clinic every 2 months for an examination, as described above– whenever the PD value of any surface exceeded by 3 mm or more the value recorded at baseline, the tooth was "exited" from the study for treatment by scaling and root planing. The results indicated that mean values for clinical and microbiological parameters changed little, if at all, between examinations for the 19 subjects who completed the study. However, significant differences were noted for clinical as well as microbiological measurements between individual subjects in the study. Positive correlations were established between % motile rods and GI and PII, between % spirochetes and PII and PD, and a negative correlation between % coccoid ceils and PII, when sampled surfaces only were considered. Significant positive correlations were shown between GI, PII and PD values, but not between RD values and GI, PII or PD. 6 subjects without exited teeth exhibited no significant differences with respect to mean PII, GI, PD or RD values for seven examinations from subjects which had two or more teeth exited from the study. However, subjects without exited teeth had significantly elevated proportions of coccoid cells and decreased proportions of motile rods and spirochetes as compared to subjects with two or more exited teeth. The proportions of spirochetes with or without motile rods in samples obtained at baseline were shown to be good predictors of periodontal deterioration as determined by the number of teeth which were exited for each subject during the course of this study. None of the clinical measurements could be used in this predictive capacity.

J Lindhe et al. in 1982[86] carried out an investigation on 15 individuals who were referred for treatment of moderately advanced periodontal disease. All patients were first subjected to a baseline examination comprising assessment of oral hygiene and gingival conditions, probing depths and attachment levels. Following case presentation and instructions in oral hygiene measures, the patients were given periodontal treatment utilizing a split mouth design. In one side of the jaw scaling and root planing were performed in conjunction with a modified Widman flap procedure while in the contralateral jaw quadrants the treatment was restricted to scaling and root planing only. The period from initial treatment to 6 months after treatment was considered to be the healing phase and from 6-24 months after treatment the maintenance phase.

During the healing phase the patients were recalled for professional tooth cleaning once every 2 weeks. During the maintenance phase the interval between the recall appointments was extended to 3 months. Re-examinations were carried out 6, 12 and 24 months after the completion of active treatment. The results revealed that treatment resulted in loss of clinical attachment in sites with initially shallow pockets, while sites with initially deep pockets gained clinical attachment. With the use of regression analysis "critical probing depths" were calculated for the two methods of treatment used. It was found that the critical probing depth value for scaling and root planing was significantly smaller than the corresponding value for scaling and root planing used in combination with modified Widman flap surgery. In addition, the surgical modality of therapy resulted in more attachment loss than the non-surgical approach when used in sites with initially shallow pockets. On the other hand, in sites with initial probing depths above the critical probing depth value more gain of clinical attachment occurred following Widman flap surgery than following scaling and root planing.

The data obtained from the re-examinations 12 and 24 months after active treatment demonstrated that the probing depths and the attachment levels obtained following active therapy and healing were maintained more or less unchanged during a maintenance care period which involved careful prophylaxis once every 3 months. However, the data also disclosed that the level of oral hygiene maintained by the patients during healing and maintenance was more critical for the resulting probing depths and attachment levels than the mode of initial therapy used. Thus, sites which during the maintenance period were found to be free from supragingival plaque were associated with shallow pockets and maintained attachment levels. In contrast, sites which harboured plaque exhibited increasing probing depths and further attachment loss.

Bacterial specificity in human periodontal diseases suggests the possibility of diagnosing and treating periodontitis as specific infections and using microbiological diagnostic means to evaluate the efficacy of periodontal therapy. In a series of clinical trials B. G. Rosling et al.[89] in 1986 tested the usefulness of topical antimicrobial agents in combination with surgical and non-surgical conventional periodontal therapy. The healing result was estimated by monitoring probing attachment levels (PAL). The usefulness of clinical and microbiological parameters to evaluate post-treatment healing result was tested. 9 of the patients exhibiting sites with recurrent periodontal disease were then evaluated for clinical and microbiological parameters to define accurate means to differentiate between active and inactive periodontal disease. The results showed that the frequency of periodontal lesions with significant loss of PAL after treatment was less in patients treated with antimicrobial agent. Specific microbiological parameters showed stronger correlation than clinical parameters with gain and/or loss of PAL post-treatment. Thus actinobacillus actinomycetemcomitans and bacteroides gingivalis occurred in periodontal lesions with progressing disease after treatment, but were rarely detected in samples from pockets of the same depths which did not exhibit further loss of PAL over a study period of 1 year. This study

points to the usefulness of topical antimicrobial agent as an adjunct to mechanical subgingival debridement in the treatment of periodontitis in adults. The results also indicate the utility of diagnostic microbiology in the assessment of periodontal disease activity post-treatment.

A study was done by Nakagawa T et al.[91] in 1990 to determine the optimal concentration of a povidone-iodine solution (Neojodin: NJD) for irrigation of subgingival pockets. Three different dilutions were prepared (undiluted, 20%, and 10%). Statistically significant reduction of total colony forming units (CFU) was shown after irrigation with undiluted NJD solution when compared to control sites. Although reduction was not significant after irrigation with 20% or 10% NJD solution, total CFU were reduced to less than 1% in several sites, which was not true with biological saline.

Data from several sources demonstrate that disease-active and disease-inactive periodontal pockets exist, but currently available diagnostic procedures do not permit identification of disease-active sites at any given point in time. Using the experimental gingivitis model, G. Rutger Persson et al.[98] in 1990 have performed studies aimed at determining whether levels of the enzyme aspartate aminotransferase (AST) in gingival crevicular fluid correlate with the presence and extent of periodontal inflammation. Gingival inflammation was assessed using the gingival index and the sulcular bleeding index, and enzyme activity was measured using a standard procedure. According to the data there was a statistically significant association between AST values and gingival index scores for spontaneously occurring lesions ($p < 0.02–0.04$) and experimentally induced lesions ($p < 0.0001$), as well as the extent of change in these values during developing experimental gingivitis ($p < 0.0001$) and resolving experimental gingivitis ($p < 0.0001$). The data demonstrate that AST levels can be used to assess the presence and extent of periodontal inflammation.

Previous studies have shown that aspartate aminotransferase (AST), an established serum marker for cardiac and liver damage in humans, appears in elevated concentrations in samples of gingival crevicular fluid (GCF) from ligated vs. non-ligated teeth in beagle dogs and in elevated quantities in cross-sectional GCF sampling, adjusted for collection time, from human sites with clinical signs of past or present periodontal disease as compared to healthy sites. A longitudinal study was done by Donald A. Chambers et al.[99] in 1991, in which AST was monitored quarterly over a 2-year period at 2 sites/tooth in 31 patients with mild to moderate adult periodontitis. In this study sample, 40 (2.6%) of 1536 sites exhibited confirmed loss of at least 2 mm of attachment during the 2-year observation period. In comparison with healthy sites within the same patients, AST standardized to a 30-second collection interval (AST30) was elevated at these sites with new confirmed attachment loss, and at sites with past attachment loss or gingivitis in the absence of periodontitis. When both within and between patient variation were taken into account, observed odds-ratios associating enzyme with disease were higher for sites with new attachment loss (9-16 depending on test cut-point) than for sites with

pre-study attachment loss (3-12), or gingivitis in the absence of periodontitis (5-8). AST in GCF is strongly related to human periodontal disease. The data are consistent with the hypothesis that the relationship is strongest during episodes of cumulative tissue breakdown, but the small numbers of sites with confirmed attachment loss during the study period, or with gingivitis in the absence of periodontitis.

Gregory Nosa et al.[88] in 1991, conducted a study to evaluate the penetration depth of the water coolant for medicament lavage of an ultrasonic device into the periodontal pocket. Patients having teeth previously planned for extraction, and exhibiting probing depths 3 mm or greater were used in this study. A reference notch was placed on the tooth at the level of the gingival margin and the probing attachment level (PAL) was measured from the base of the notch to the base of the pocket. The ultrasonic device, with an EWPP tip and equipped with a reservoir of erythrocin dye coloured coolant, was activated and moved in a vertical direction from the gingival margin to the apical extent of the pocket. The tooth was extracted and the penetration depth (PD) of the dye-coloured water spray was measured from the reference notch to the apical limit of the stained subgingival plaque. The tooth was counter stained with methylene blue to determine the coronal extent of the connective tissue attachment. Pearsons' product moment correlation coefficient for the PAL and PD was calculated. Dye-stained root surface was observed along the full extent of the probe tip's penetration path. The dispersion of the dye-coloured stain was localized to the area of the ultrasonic probe with very little lateral dispersion. The ultrasonic instrument may be an effective system to mechanically remove plaque and calculus at the same time as delivering a chemotherapeutic agent. The limited dispersion of the liquid dye would indicate that chemical plaque control with this delivery system is dependent upon thorough debridement with the instrument such that all affected surfaces are instrumented.

In a study by Thomas E. Rams et al.[97] in 1996, the predictive utility of 5 major putative periodontopathic microbial species, “superinfecting” organisms, and several clinical periodontal parameters were assessed relative to periodontitis recurrence over a 12-month period in 78 treated adult patients participating in a 3-month maintenance care program. At baseline, pooled subgingival microbial samples were collected from each patient, and whole mouth evaluations of probing depth, relative periodontal attachment level, furcation involvement, and indices of plaque and gingival inflammation were carried out. 67 (85.9%) subjects were culture-positive at baseline for presence of either actinobacillus actinomycetemcomitans, porphyromonas gingivalis, prevotella intermedia. campylobacter rectus or peptostreptococcus micros, with 48 (61.5%) subjects yielding one or more of these species at or above designated threshold proportions of $\geq$ 0.01% for A. actinomycetemcomitans, $\geq$ 0.1% for P. gingivalis, $\geq$ 2.5% for P. intermedia, $\geq$ 2.0% for C. rectus, and $\geq$ 3.0% for P. micros. Subgingival yeasts were recovered from 12 subjects, staphylococci from 7, and enteric rods/pseudomonads from 6; however, no subjects revealed 21.0% baseline proportions of these “superinfecting” organisms in subgingival specimens. Periodontitis recurrence

in subjects was defined as any periodontal site exhibiting either a probing depth increase of 2:3 mm from baseline, or a probing depth increase of 22 mm from baseline together with a loss in relative periodontal attachment of 22 mm from baseline. 15 (19.2%) study subjects showed periodontitis recurrence within 6 months of baseline, and 25 (32.1%) within 12 months. The mere baseline presence of the 5 major test species and "superinfecting" organisms were not significant predictors of periodontilis recurrence over 12 months. However, a 2.5 relative risk for periodontitis recurrence over 12 months was found for subjects yielding one or more of the 5 major test species at or above the designated baseline threshold proportions. The positive predictive value for periodontitis recurrence of a microbiologic analysis encompassing the 5 major test species at or above the designated threshold proportions improved with increasing time from baseline, up to approximately 42% at 12 months. Baseline variables jointly providing in multiple regression analysis the best predictive capability for periodontitis recurrence in subjects over a 12-month period were recovery of one or more of the 5 major test species at or above designated threshold proportions, the proportion of sites per subject with 25 mm probing depth, and the mean whole mouth probing depth. These findings indicate that one or more of 5 major putative periodontal pathogens in elevated subgingival proportions together with increased probing depth predispose adults on maintenance care to recurrent periodontitis.

M.A. Cugini et al.[90] in 2001 reported that SRP resulted in a decrease in mean pocket depth and attachment level and reduced prevalence and levels of bacteroides forsythus, porphyromonas gingivalis, and treponema denticola at 3 and 6 months post-SRP in 57 subjects with adult periodontitis. 32 of the 57 subjects were monitored at 9 and 12 months. Thus, the purpose of the present investigation was to evaluate the microbial and clinical effects of SRP in 32 (mean age 48±11) subjects over a 12-month period. Clinical assessments of plaque, gingival redness, suppuration, bleeding on probing, pocket depth and attachment level were made prior to SRP and at 3, 6, 9, and 12 months post-therapy. Subgingival plaque samples were taken at each visit and analysed using the checkerboard DNA-DNA hybridization technique for the presence and levels of 40 subgingival species. Each subject also received maintenance scaling at each of the subsequent monitoring visits. Differences in clinical parameters and prevalence and levels of bacterial species were analysed pre and post-therapy using the Wilcoxon signed ranks test. The Quade test for related samples was used for analysis of multiple visits. Mean pocket depth (mm±SEM) decreased from 3.2±0.3 at baseline to 2.9±0.3 at 12 months ($p < 0.01$). Mean attachment level showed significant reduction at 6 months, but did not diminish further. Bleeding on probing and plaque were significantly reduced at 12 months. P. gingivalis, B. forsythus and T. denticola decreased in prevalence and levels up to the 6-month visit and remained at these lower levels at 9 and 12 months. Significant increases in levels and prevalence were noted at 12 months for actinomyces naeslundii genospecies, actinomyces odontolyticus, fusobacterium nucleatum ss polymorphum, streptococcus mitis, capnocytophaga sp,

and veillonella parvula. The data suggests that the maintenance phase of therapy may be essential in consolidating clinical and microbiological improvements achieved.

Patients Role in Supportive Periodontal Therapy

A study was done by David M. Lamberts et al.[113] in 1982 to determine the effectiveness of waxed and unwaxed floss in plaque removal and on gingival health when used in a home oral hygiene program. 80 patients, having previously received periodontal therapy, were divided into four similar groups, according to the S-OHI. Each group represented four different types of dental floss being tested: Butler waxed, Butler unwaxed, Johnson and Johnson waxed, and Johnson and Johnson unwaxed. After receiving a thorough prophylaxis, each patient received oral hygiene instruction with a video tape, and was given a toothbrush and a quantity of test floss. At 0, 28 and 56 day intervals, the patients were scored for plaque and gingivitis. The data were then analysed statistically using analysis of variance. It was found that there was no statistical difference among the four different types of tested floss as far as their plaque removal ability or prevention of gingivitis is concerned.

In a study done by Richard C. Wunderlich et al.[114] in 1982, 80 patients, having received periodontal therapy previously, were divided into four groups, corresponding to one of four different types of dental floss being used. Seven to ten days after receiving a thorough prophylaxis, each patient had oral hygiene instructions by video tape, was given a toothbrush and a quantity of the test floss. At 0, 28 and 56 day intervals, the patients were scored for crevicular fluid flow and gingival bleeding. Data were analysed statistically. Johnson and Johnson unwaxed dental floss was found to be slightly less effective in reducing gingival bleeding at the 56th day. It was also found that crevicular fluid flow was least with waxed floss use in the 56 day session. However, the range of variations was so minimal that no clinical significance could be ascribed to either finding. There were patients in each of the four floss groups with no fluid flow or bleeding during all three sessions.

The effectiveness of Super Floss® and waxed dental floss as proximal surface cleansing agents was compared in 34 subjects in a study done by C.H. Wong et al.[117] in 1985. Each subject used I agent twice daily for 2 weeks followed by the other agent used with the same frequency and for the same period. The order in which the agents were used was selected at random. Plaque was stained by erythrosin, and a plaque index of Wolffe used. Super Floss® was found to be superior to waxed dental floss in removing proximal plaque, but neither was 100% effective. Some plaque was present in 49.9% of the proximal surfaces when Super Floss® had been used and on 54.7% when the waxed dental floss had been used. Both agents cleaned distal surfaces better than mesial surfaces, proximal surfaces of anterior teeth more effectively than those of posterior teeth, the coronal half of the proximal surfaces better than the apical half and the facial half more efficiently than the lingual half. No differences were found between maxillary teeth and mandibular teeth. Subjects used more lengths of Super

Floss® than of waxed dental floss, indicating its relative 'brittleness'. However, the majority of subjects preferred Super Floss®, mainly because it was thicker and felt more abrasive.

In a study done by Rober Kiger et al.[111] in 1991, the removal of interproximal plaque was compared using a standard toothbrush alone, a toothbrush with unwaxed dental floss and a toothbrush with an interdental brush. 30 previously treated periodontal patients were given the cleaning aids in a three-way crossover study design. After each 1-month trial period, scores for gingivitis, buccal/lingual plaque and proximal plaque were recorded. Mean GI scores for subjects were 0.37 using the toothbrush only, 0.36 using the toothbrush with floss and 0.32 using the toothbrush with the interdental brush. Mean buccal/lingual plaque scores were 0.64 using the toothbrush only, 0.62 using the toothbrush with floss and 0.51 using the toothbrush with the interdental brush. Mean proximal plaque scores were 2.32 with the toothbrush only, 1.71 using the toothbrush with floss and 1.22 using the toothbrush with the interdental brush. Statistically significant differences were seen in proximal plaque scores between the 3 treatment groups. The results indicate that the interdental brush used in combination with a toothbrush is more effective in the removal of plaque from proximal tooth surfaces than a toothbrush used alone or in combination with dental floss.

Removing plaque from interproximal areas is critical in preventing periodontal disease recurrence. Studies have shown the Interplak counter-rotational powered brush is more proficient at this than conventional methods. A study was done by Yukna RA[105] in 1993 to compare the effectiveness of the counter-rotational powered brush with conventional methods on mid-radicular and interproximal surfaces. Periodontal surgery patients who were in supportive periodontal therapy were grouped into those using the counter-rotational powered brush device and those using conventional methods. Various measures of periodontal health indicated that over the 6-month study period, the counter-rotational powered brush resulted in a 40% to 60% improvement in clinical periodontal conditions compared with a 15% to 40% improvement with conventional methods.

In order to evaluate the effectiveness of a counter-rotational powered brush (CRPB) during the supportive periodontal therapy (SPT) phase of periodontal treatment, 40 treated patients in SPT but with insufficient plaque control were randomly divided into equal experimental or control groups in a study done by Yukna RA et al106 in 1993. All subjects used the same toothpaste, but the CRPB group did not use any interproximal aids. Gingivitis (MGI), plaque, and bleeding on probing (BOP) were scored at baseline and 1, 3, and 6 months prior to prophylaxis in conjunction with regular SPT visits. While both groups improved from baseline, CRPB use achieved significantly lower mean plaque scores and BOP at 6 months as analysed by repeated measures ANOVA. The CRPB also showed consistent statistically superior percentage changes from baseline resulting in a general 50% improvement in clinical conditions compared to a 20 to 25% improvement for control oral hygiene methods. CRPB use

resulted in at least a 50% improvement from baseline twice as often as did the control. The results of this study demonstrate more substantial and consistent improvement in periodontal conditions and plaque control effectiveness with the CRPB than the control methods that included interproximal hygiene aids. It appears that the CRPB may be a useful adjunct in maintaining reduced plaque levels and favourable gingival conditions in patients in the SPT phase of periodontal therapy.

The purpose of the study done by Vassiliki Christou et al.[112] in 1998 was to compare in untreated patients suffering from moderate to severe periodontitis the efficacy of dental floss (DF) and interdental brushes (IDB) in the reduction of plaque, gingival inflammation, and probing depth in a 6-week period prior to subgingival debridement. 26 patients (12 female, 14 male; mean age– 37.4 years; range– 27 to 72 years) were instructed to use DF for one side of the dentition and IDB for the other side as an adjunct to the daily tooth-brushing for 6 weeks. Oral hygiene instructions for tooth-brushing and the use of the two devices were given at baseline and at week 3. Measurements were carried out at baseline and at 6 weeks including plaque scores, probing depth, and 2 bleeding scores (periodontal pocket bleeding index and angulated bleeding index). With the IDB, the approximal plaque score at baseline of 3.09 reduced to 2.15 at 6 weeks and with DF, from 3.10 to 2.47, respectively. IDB proved to remove significantly more plaque than DF. Baseline probing depth of 5.84 mm for IDB sites and 5.59 mm for DF sites was reduced to 5.01 mm at 6 weeks for both regimens. Analysis showed that the use of IDB resulted in a greater pocket reduction. Both bleeding indices were slightly reduced with IDB and DF, but no differences between devices were found. In relation to patient acceptance, more problems were observed with DF, and IDB were felt to be more efficacious. In conclusion, the results of the present study indicate that in combination with a manual toothbrush, the use of interdental brushes is more effective in removal of plaque and results in a larger reduction of probing depth than the use of dental floss. Although the differences were small, they indicate, in combination with patient preferences, that interdental brushes are to be considered preferable to floss for interdental plaque removal in patients suffering from moderate to severe periodontitis.

Periodontal Risk Assessment (PRA) for Patients in Supportive Periodontal Therapy (SPT)

P. Axelsson and J. Lindhe in 1981[3] had done a study to assess the efficacy of a maintenance care program to prevent recurrence of disease in patients subjected to treatment of advanced periodontitis. In addition, the periodontal status was monitored of a group of patients who following the end of active treatment were referred back to general practitioners for maintenance care. The material consisted of 90 patients who in 1972 were referred for specialist treatment of advanced periodontal disease. The patients were first subjected to an initial examination including assessment of oral hygiene, gingivitis, probing depths and attachment levels. They were instructed

how to practice proper tooth-cleaning methods, their teeth were scaled and eventually the periodontal pockets were treated using the modified Widman technique. During the first 2 months following surgery the patients were recalled once every 2 weeks for professional tooth-cleaning. Two months after the end of surgical treatment, the patients were re-examined to provide baseline data. Every third patient was thereafter referred back to the general dentist for maintenance care. Two out of three patients were maintained in a carefully designed and controlled maintenance care program at the university clinic. This program involved recalls once every 2-3 months and included instruction and practice in oral hygiene, meticulous scaling and professional tooth-cleaning. The patients were re-examined 3 and 6 years after the baseline examination. The results demonstrated that in patients suffering from destructive periodontitis, a treatment program that involved oral hygiene instruction, scaling, root planing and modified Widman flap procedures resulted in the establishment of clinically healthy gingiva and shallow pockets. Patients who were placed on a carefully designed recall program were over a 6-year period able to maintain excellent oral hygiene standards and unaltered attachment levels. In contrast patients who subsequent to active treatment were not maintained in a supervised program showed obvious signs of recurrent periodontitis at the follow-up examinations.

William Becker, Burton E. Becker, and Lawrence E. Berg[4] in 1984 had done a study on 44 patients who were treated for periodontal disease and for varying reasons elected not to participate in the maintenance aspect of periodontal care. All patients were initially given intensive instructions in personal oral hygiene, along with initial scaling and root planing. Each patient had two or more quadrants of pocket reduction therapy. Tooth mortality revealed a mean annual adjusted tooth loss rate of 0.22 (4.7%). Between examinations, breakdown in the health status of furcations was noted. Mean probing depth scores at the second examination showed no significant differences from the first examination scores. Measurements of bone levels revealed a worsening of bone scores between examinations. The results of this study show that periodontal therapy without maintenance is of little value in terms of restoring periodontal health.

In a study done by Jan Bergstrom et al[163] in 1986, changes in probing pocket depth following non-surgical periodontal treatment were investigated in 75 patients, 40 of whom were heavy smokers. Pockets with an initial probing depth of 4-6 mm were studied. The treatment consisted of patient instruction and motivation and debridement of plaque and calculus by hand instrumentation. The treatment was completed within 5 months and probing depth was recorded prior to and 1 month following the completion of therapy. Plaque index was reduced to a minimum in both smokers (P1I=0.2) and non-smokers (P1I=0.1) following treatment. An average reduction in probing pocket depth of 1.1 mm in smokers and 1.2 mm in non-smokers was observed. The reduction attained was less in smokers than in non-smokers for all regions of the dentition investigated. The greatest difference between groups was observed for the maxillary anterior region.

In a study done by Jan Bergstrom et al.[160] in 1989, patients were admitted to the School of Dentistry, Stockholm, for treatment of chronic periodontal disease during the years 1980-82. They were retrospectively investigated with respect to their smoking habits. The investigation was designed as a case control study and covered all patients of 30, 40, or 50 years of age upon admission. The periodontal variables under scrutiny were frequency of periodontally diseased teeth, frequency of periodontally diseased sites (probing depth > 4 mm), gingival index, and plaque index. The overall occurrence rate of smokers in the sample of cases was 56%, which is significantly greater than the population at large. This held true for all three age cohorts and for men as well as women. The risk ratio was 2.5, indicating more prevalent disease among smokers. Further, significantly greater frequencies of periodontally involved teeth and diseased sites were found in smokers, indicating more severe disease among smokers. Gingival index and plaque index did not notably differ between smoking groups. The results suggest increased prevalence as well as severity in smokers. Smoking, therefore, should be considered a risk factor for chronic periodontal disease.

In a study done by Jan Bergstrom et al.[164] in 1990, the influence of cigarette smoking on the outcome of surgical therapy was investigated in 54 patients, 24 of whom were smokers. The patients had moderate to severe periodontitis with persisting diseased pockets after non-surgical therapy. The surgical modality used was the modified Widman flap operation and the pockets under scrutiny were those with an initial probing depth of 4-6 mm. Re-examination was made 12 months following the completion of surgery. The probing depth reduction at the 12-month follow-up was 0.76±0.36 mm (mean±SD) in smokers as compared to 1.27 0.43 mm in non-smokers. The difference was statistically significant ($P < 0.001$) and persisted after accounting for plaque. The results suggest that smoking may impair the outcome of surgical therapy.

A study was to done by Anita Badersten et al.[138] in 1990 determine the diagnostic value of clinical scores of supragingival plaque, bleeding, suppuration and probing depth to predict probing attachment loss in patients on maintenance following non-surgical periodontal therapy. Non-molar teeth in 39 subjects were monitored and the above scores were repeatedly obtained throughout 5 years of observation following initial treatment. Probing attachment loss between 0-60 months was determined by a combination of linear regression analysis and end-point analysis. The results revealed that all the investigated scores were associated with probing attachment loss. This association was demonstrated by improved diagnostic predictability along with increased frequency or magnitude of the various scores. Also, the diagnostic predictability improved with increase in length of time for recording of the scores. The diagnostic predictability of either accumulated plaque scores and accumulated bleeding scores reached a maximum of about 30%. Residual probing depth ≥ 7 mm reached a predictability of around 50% and increase in probing depth ≥ 1.0 mm reached about 80% after 60 months. Thus, of the clinical scores investigated, increase

in probing depth was found to be most valuable in predicting probing attachment loss.

In a study done by Noel Claffey et al.[139] in 1990, recordings of supragingival plaque, bleeding, suppuration and probing depth were obtained for 42 months following initial periodontal therapy. Scores accumulated after various time intervals during monitoring were studied for their predictive value in revealing probing attachment loss as determined by regression analysis during the 0-42 month period. Accumulated plaque scores demonstrated low predictability. Accumulated bleeding scores showed modest predictive values. Suppuration on probing was not a frequent finding during the observation interval and also had modest predictive power. Increase in probing depth compared to baseline and deep residual probing depth had modest predictability after 3 and 12 months, but showed increasing accuracy in revealing probing attachment loss over later time intervals. After a few years of maintenance, increase in probing depth, particularly if combined with high frequency of bleeding on probing, showed the highest predictive value for probing attachment loss of the scores examined.

The association between smoking and loss of periodontal bone height was investigated in Swedish dental hygienists by Jan Bergstrom et al.[161] in 1991. The study group included 210 subjects: 24 to 60 years of age, 30% smokers, 32% former smokers, and 38% non-smokers. The study was based on bitewing radiographs, where loss of the interproximal bone height was measured as the distance from the cementoenamel junction (CEJ) to the interdental septum (IS). The magnitude of the CEJ-IS distance was read at 12 sites, representing 3 maxillary and 3 mandibular bone septa in each subject. The CEJ-IS distance was significantly greater for smokers when compared to non-smokers, mean ± SEM 1.71±0.08 mm and 1.45±0.04 mm, respectively. The mean ± SEM for former smokers was 1.55±0.05 mm. In smokers, the CEJ-IS distance increased with increased smoking exposure. The results, based on adults with good oral hygiene, suggest that loss of periodontal bone is related to smoking. The smoking related bone loss is not correlated with plaque infection.

In a study done by Andreas Joss et al.[137] in 1994 following active periodontal therapy, 39 patients were incorporated in a program of supportive periodontal therapy for a period of 53 months with recall intervals varying between 2-8 months. The patients received supportive therapy 7 to 14x. At the beginning of each maintenance visit, the tissues were evaluated using BOP. Re-instrumentation was only performed at sites which bleed on probing. However, supragingival plaque and calculus were always removed. Probing depth and probing attachment levels were determined after active treatment and at the conclusion of the study. Progression of periodontal disease was defined by a measured loss of probing attachment of 2 mm or more. During the observation period, 4.2% of all the sites lost attachment. Approximately 50% of these losses were due to periodontal disease progression, while the other half was the result of attachment loss in conjunction with recession of the gingiva. 2/3 of all the sites which lost attachment were found in a group of patients which presented a mean BOP

30%. In a group of patients with a mean BOP of 20%, only 1/5 of the loser sites were found. This clearly indicated, that patients with a mean BOP of 20% have a significantly lower risk for further loss of probing attachment at single sites.

Michele K. Baumert Ah et al.[167] in 1994 did a study where they evaluated the effect of smoking on the clinical response to non-surgical and surgical periodontal therapy. 74 adult subjects with moderate to advanced periodontitis were treated according to a split-mouth design involving the following treatment modalities: coronal scaling, root planing, modified Widman surgery, and flap with osseous resectional surgery. Clinical parameters assessed included probing depth, probing attachment level, horizontal attachment level in furcation sites, recession, presence of supragingival plaque and bleeding on probing. Data were collected: initially, 4 weeks following phase-I therapy, 10 weeks following phase-II therapy and on a yearly basis during 6 years of maintenance care. Data analysis demonstrated that smokers exhibited significantly less reduction of probing depth and less gain of probing attachment level when compared to non-smokers immediately following active therapy and during each of the 6 years of maintenance ($p < 0.05$). A greater loss of horizontal attachment level was evident in smokers at each yearly exam during maintenance therapy ($p < 0.05$). There were no differences between groups in recession changes. In general, these findings were true for the outcomes following all 4 modalities of therapy and were most pronounced in the deepest probing depth category (≥ 7 mm). Statistical analysis showed a tendency for smokers to have slightly more supragingival plaque and bleeding on probing. In summary, smokers responded less favourably than non-smokers to periodontal therapy which included 3-month maintenance follow-up.

Tonetti et al.[165] in 1995 conducted a retrospective study where they examined the effect of cigarette smoking on the healing response following guided tissue regeneration (GTR) in deep infrabony defects. 71 defects in 51 patients underwent GTR with teflon membranes. 20 patients (32 defects) smoked more than 10 cigarettes per day, while 31 patients (39 defects) did not smoke. Clinical measurements were available at baseline, at membrane removal and at the 1-year follow-up. The oral hygiene of both groups was good, but smokers had significantly higher full mouth plaque scores. No significant differences were observed between smokers and non-smokers in terms of percentage of tissue gained at membrane removal. At the 1-year follow up, however, smokers gained significantly less probing attachment level than non-smokers (2.1±1.2 mm compared with 5.2±1.9 mm). A multivariate model, correcting for the oral hygiene level of the patients and the depth of the infrabony component, indicated that smoking was in itself a significant factor in determining the clinical outcome. A risk-assessment analysis indicated that smokers had a significantly greater risk than non-smokers to display a reduced probing attachment level gain following GTR. It is concluded that cigarette smoking is associated with a reduced healing response after GTR treatment, and may be responsible, at least in part, for the observed results.

SPT in Daily Practice

A study was done by Sture Nyman et al.[168] in 1986 to examine if root debridement in the treatment of periodontal disease must include the removal of the exposed cementum in order to achieve periodontal health. Five beagle dogs were used. Periodontal tissue breakdown around the second, third and fourth mandibular premolars was accomplished by placing plaque-collecting cotton floss ligatures around the necks of the teeth. When the destruction of the attachment apparatus after 4 months had progressed to a level corresponding to half the length of the roots, the ligatures were removed. During a subsequent period of 2 months the experimental teeth were left without ligatures but the dogs were still allowed to accumulate plaque. On day 180, the experimental teeth were subjected to (lap surgery. Following elevation of the Iiaps, the teeth on one side of the jaw were scaled and the exposed root cementum was removed using diamond burs. On the contralateral side no scaling was performed and the roots were only polished with the use of rubber cups, interdental rubber tips and a polishing paste. After irrigation of the roots with sterile saline the flaps were repositioned at their original level and sutured. Following a healing period of 2 months, during which both test and control teeth were subjected to regular plaque control, the dogs were sacrificed and the jaws placed in fixative. After de-calcification, histological sections of the experimental teeth and their periodontal tissues were produced. The histometric data demonstrated that the result of healing was similar whether or not the previously exposed root cementum had been removed. In both situations a junctional epithelium with a non-inflamed subjacent connective tissue was formed. In addition, new connective tissue attachment was frequently observed at the apical extent of the wounds following both types of treatment. The results suggest that the removal of the root cementum for the purpose of eliminating endotoxins possibly present within the cementum is not necessary for accomplishing periodontal health.

S Nyman et al.[169] in 1988 conducted a clinical trial to examine whether root debridement in the treatment of periodontal disease must include the removal of the exposed cementum in order to achieve periodontal health. The study included 11 adult patients with moderate to advanced periodontal disease. In a split-mouth design, the dentition of each patient was by random selection divided into test and control quadrants comprising the incisors, canines and premolars. Following a baseline examination, all patients were given a case presentation and a detailed instruction in self-performed oral hygiene measures. The patients were then subjected to periodontal surgery. Following reverse bevel incisions, buccal and lingual mucoperiosteal flaps were elevated and all granulation tissue was removed. In 2 jaw quadrants (control quadrants) in each patient, the denuded root surfaces were carefully scaled and planed in order to remove soft and hard deposits as well as all cementum, using hand instruments and flame-formed diamond stones. In the contralateral quadrants (test quadrants) the roots were not scaled and planed but soft microbial deposits were removed by polishing the root

surfaces with the use of rubber cups, interdental rubber tips and a polishing paste. Calculus in the test quadrants was removed by the use of a curette, but precaution was taken to avoid the removal of cementum. The flaps were repositioned to their original level and sutured. The patients were following active treatment enrolled in a supervised maintenance care program including "professional tooth cleaning" once every 2 weeks for a 3-month period. From this time point until the final control, 24 months after treatment, the interval between the recall appointments was prolonged to 3 months. The results showed that the same degree of improvement of periodontal health was achieved following both types of treatment. A low-frequency of gingival sites which bled on probing or had a gingival index score of 2 and 3 was obtained in all jaw quadrants as well as a high frequency of sites with shallow pockets. Between the baseline examination and the follow-up examinations (after 6, 12 and 24 months), there was some gain of probing attachment for both treatment modalities. This gain was most pronounced in the initially deeper pockets and was similar for both treatment modalities.

A study was done by Mombelli A et al.[170] in 1995 to determine the presence of suspected periodontal pathogens in the peri-implant microflora of osseointegrated implants exposed 3 and 6 months to the oral environment of patients previously treated for periodontal disease. Subgingival microbial samples were taken in the deepest residual pocket of each quadrant in 10 patients before placement of ITI implants and in 10 patients before abutment connection of Brånemark implants. The samples were cultured using continuous anaerobic techniques. 4 patients were positive for P. gingivalis, 13 for P. intermedia, 2 for A. actinomycetemcomitans, 16 for Fusobacterium, 1 for C rectus and 12 showed microscopic evidence of spirochetes. After 3 and 6 months exposure of the implants to the oral environment, one sample was obtained from the peri-implant sulcus in each patient. P. gingivalis was found in 2 patients in the peri-implant samples after 3 and 6 months. 6 peri-implant samples were positive for P. intermedia after 3 months, 7 after 6 months. Fusobacterium was present in 13 peri-implant samples after 3, and in 12 samples after 6 months. 4 patients showed evidence of for C rectus after 3 months, 2 after 6 months. Spirochetes were seen in 3 peri-implant samples after 3 and in 5 after 6 months. None of the implants were found to be colonized by A. actinomycetemcomitans, although the organism was detected on teeth in 1 individual. Similar distribution patterns were noted for ITI and Brånemark type implants. In comparison to fully edentulous and periodontally healthy individuals, the patients of this study showed a high peri-implant prevalence of anaerobic putative periodontal pathogens 3 to 6 months after exposure of the implants to the oral environment.

SPT For Patients With Periodontitis

Jan Lindhe and Sture Nyman in 1984[22] evaluated the periodontal conditions of a group of patients who, following active treatment of extremely advanced periodontal

disease, had been maintained for 14 years in a well-supervised maintenance care program. The sample included 61 subjects out of an initial group of 75 individuals who in 1969 were referred to and treated by the authors. Following an initial examination, the patients were given detailed instructions in proper plaque control measures and were subjected to scaling and root planing and surgical elimination of pathologically deepened pockets. After the termination of the active treatment phase, the patients were placed in a maintenance care program including recall appointments every 3-6 months. At the initial examination, immediately after the completion of the active treatment phase and then once a year, all patients were examined regarding oral hygiene, gingival conditions, probing depths and clinical attachment levels. In addition, the interproximal alveolar bone height was determined from full mouth radiographs obtained before active treatment, at the completion of active therapy and 1, 3, 5, 8, 10, 12 and 14 years after treatment. The results from the repeated examinations demonstrated that treatment of advanced forms of periodontal disease resulted in clinically healthy periodontal conditions and that this state of "periodontal health" could be maintained in most patients and sites over a period of 14 years. It was also demonstrated that the treatment and maintenance programs described were equally effective in young and older patients. The individual mean values describing probing depths, attachment levels, and bone heights did not vary significantly over the 14 years of observation. A more detailed analysis of the data revealed that a small number of sites in a few patients lost a substantial amount of attachment. This attachment loss occurred at different time intervals during the course of the maintenance period. Thus, 43 surfaces in 15 different patients were exposed to recurrent periodontal disease of a significant magnitude. This recurrent inflammatory periodontal disease caused the loss of 16 teeth in 7 different patients during the maintenance period.

In a study done by Badersten A et al.[60] in 1987, a total of 2214 sites from incisors, cuspids, and premolars were studied in 46 adult periodontitis patients following treatment consisting of plaque control and root debridement. The periodontal status at 24 months was used as baseline for observations during the subsequent 24-48 month interval which included 4 recall visits for debridement at the 24, 30, 36, and 42-month time points. The data were analysed for pooled groups of sites of different probing depth at 24 months: ≤ 3.5 mm, 4.0-6.5 mm, and ≥ 7.0 mm. The results showed little change during the 24-48 month interval in mean scores for bleeding on probing, probing depth, and probing attachment level for all 3 groups of sites. Individual sites with probing attachment loss during the 24-48 month period were identified. The frequency of such sites was similar, irrespective of 24-month probing depth. The sites identified with probing attachment loss during the 24-48 month interval generally differed in location from those identified as having probing attachment loss during the proceeding 0-24 month period. Often, the loss of probing attachment during the 24-48 month interval seemed to be a reversal of a prior gain in probing attachment during

the 0-24 month interval. This study in non-molar teeth of subjects with generally good level of compliance failed to demonstrate that sites with deeper probing depth were more difficult to maintain than shallower sites.

SPT for Patients with Implants

In a study done by Brånemark et al.[173] in 1981, a total of 2895 threaded, cylindrical titanium implants have been inserted into the mandible or the maxilla and 124 similar implants have been installed in the tibial, temporal or iliac bones in man for various bone restorative procedures. The titanium screws were implanted without the use of cement, using a meticulous technique aiming at osseointegration-a direct contact between living bone and implant. 38 stable and integrated screws were removed for various reasons from 18 patients. The interface zone between bone and implant was investigated using X-rays, SEM, TEM and histology. The SEM study showed a very close spatial relationship between titanium and bone. The pattern of the anchorage of collagen filaments to titanium appeared to be similar to that of Sharpey's fibres to bone. No wear products were seen in the bone or soft tissues in spite of implant loading times up to 90 months. The soft tissues were also closely adhered to the titanium implant, thereby forming a biological seal, preventing microorganism infiltration along the implant. The implants in many cases had been allowed to permanently penetrate the gingiva and skin. This caused no adverse tissue effects. An intact bone-implant interface was analysed by TEM, revealing a direct bone-to-implant interface contact also at the electron microscopic level, thereby suggesting the possibility of a direct chemical bonding between bone and titanium. It is concluded that the technique of osseointegration is a reliable type of cement-free bone anchorage for permanent prosthetic tissue substitutes. At present, this technique is being tried in clinical joint reconstruction. In order to achieve and to maintain such a direct contact between living bone and implant, threaded, unalloyed titanium screws of defined finish and geometry were inserted using a delicate surgical technique and were allowed to heal in situ, without loading, for a period of at least 3-4 months.

Quirynen et al.[177] in 1990 did a study which involved 108 patients (age 38-82 years) rehabilitated with overdentures in the lower jaw supported by 2 endosseous screw-shaped implants. At each follow-up visit, the clinical attachment level (PAL) around the implants was assessed with a Merrit-B probe or a constant force electronic probe, peri-probe, and biannually parallel long-cone radiographs were taken to locate the marginal bone level. These data were used to examine the relationship between bone and attachment level estimations around implants. As a mean, bone level was scored 1.4 mm apically of PAL and this difference remained constant with time. The Pearson correlation coefficient between bone level and PAL, for mesial and distal sites, was 0.67 and 0.61 for the Merrit-B probe, and 0.76 and 0.65, respectively for the peri-probe. The highest correlations were obtained for sites with a healthy gingiva or in absence of intra-bony craters. Duplicate PAL registrations showed a standard deviation

for the intra-examiner variability of 0.37 (peri-probe) or 0.40 mm (Merrit-B probe) with more than 90% of the variation within 0.5 mm. The mean difference in PAL between Merrit-B probe or peri-probe was 0.05 mm. It was concluded that the clinical attachment level determination is a reliable indicator for bone level around implants with a moderate healthy gingiva.

Lindhe et al.[175] in 1996 did a study to determine the dimension of the mucosal-implant attachment at sites with insufficient width of the ridge mucosa. 5 beagle dogs were used. Extractions of all mandibular premolars were performed and 3 months later. 3 fixtures of the Brånemark System® were installed in each side. Following 3 months of healing, abutment connection was carried out. On the right or left side of the mandible, abutment connection was performed according to the Brånemark System® manual (control side). On the contralateral side (test side), an incision not extending through the periosteum was made at the crest of the ridge. The soft tissue was dissected and a critical amount of connective tissue on the inside of the flap was excised. The periosteum was subsequently incised, abutment connection performed, and the trimmed flaps sutured. The sutures were removed after 10 days. After a 6-month period of plaque control, the animals were sacrificed, biopsies sampled and processed for light microscopy. The length of the junctional epithelium varied within a rather narrow-range: 2.1 mm (control side) and 2.0 mm (test side). The height of the suprabony connective tissue in this model varied between 1.3±0.3 mm (test side) and 1.8±0.4 mm (control side). At sites where the ridge mucosa prior to abutment connection was made thin (≤ 2 mm), wound healing consistently included bone resorption. This implies that a certain minimum width of the peri-implant mucosa may be required, and that bone resorption may take place to allow a stable soft tissue attachment to form.

According to Lang et al.[178] in their article in 2002,they had said that biofilms form on all hard non-shedding surfaces in a fluid system, i.e. both on teeth and oral implants. As a result of the bacterial challenge, the host responds by mounting a defence mechanism leading to inflammation of the soft tissues. In the dento-gingival unit, this results in the well-described lesion of gingivitis. In the implanto-mucosal unit, this inflammation is termed “mucositis”. If plaque is allowed to accumulate for prolonged periods of time, experimental research has demonstrated that “mucositis” may develop into “peri-implantitis” affecting the peri-implant supporting bone circumferentially. Although the bony support may be lost coronally, the implant still remains osseointegrated and hence, clinically stable. This is the reason why mobility represents an insensitive, but specific diagnostic feature of “peri-implantitis”. More sensitive and more reliable parameters of developing and existing peri-implant infections are “bleeding on probing”, “probing depths” and radiographic interpretation of conventional or subtraction radiographs. Depending on the diagnosis made continuously during recall visits, a maintenance system termed Cummulative Interceptive Supportive Therapy (CIST) has been proposed.

Restorative Dentistry and its Effect on Periodontal Maintenance

In a study by Nyman S et al.[184] in 1982, the total area of periodontal ligament around the abutment teeth in 60 fixed bridges, inserted in patients treated for advanced periodontal disease, was calculated and compared with the total "periodontal ligament area" of the teeth replaced by politics. The calculations revealed that only in 8% of the bridge restorations did the periodontal ligament area of the abutment teeth equal or exceed that of the replaced teeth. In 57% of the bridge material the periodontal ligament area of the abutments was less than 50% of the anticipated normal ligament area of the pontics. Despite the fact that the periodontal support for the restorations was dramatically reduced, all bridges have functioned properly for 8-11 years and the periodontal tissues around the abutment teeth have not suffered further loss of attachment during the period of maintenance care.

Ingvar Ericsson et al.[181] in 1984 conducted a study to assess the inflammatory response in gingival units subsequent to the placement of restorations with subgingivally located margins. 3 beagle dogs were used. Cotton floss ligatures were placed around the neck of the mandibular third and fourth premolars of all dogs. The ligatures were exchanged once a month during the first 6 months of experiment. When 40-50% of the height of the supporting tissues had been lost in an experimental periodontitis the ligatures were removed but the animals allowed to accumulate deposits for another 60 days. The inflamed periodontal tissues were subsequently excised using either an "apically placed flap" procedure or a "gingivectomy" procedure. In the flap procedure the main part of the keratinized gingiva was preserved while in the gingivectomy procedure the keratinized part of the gingiva was removed in toto. Following scaling and root planing the animals were during a maintenance period of 4 months placed on a program involving chlorhexidine application and mechanical tooth cleaning twice daily. On Day 0 a notch was prepared in the buccal surface of each root at the level of the gingival margin. Furthermore, steel bands were placed along the buccal surface of each root of the third and fourth premolars and secured with an apical margin at the level of 1 mm apical to the notch. The bands were cemented to the root surfaces by a cement. The dogs were allowed to accumulate plaque and calculus for 6 months. Towards the end of the study a clinical examination was performed to assess the position of the steel bands in relation to the notch and the gingival margin, the presence of subgingival plaque and the condition of the gingiva. The animals were subsequently sacrificed and specimens containing' the mandibular third and fourth premolars were harvested, fixed in formalin, de-calcified and embedded in paraffin. The buccolingual sections of each root were cut with a microtome set at 4 μm and stained in hematoxylin and eosin. In the biopsies the distance between the gingival margin and the most apical cells of the junctional epithelium, the distance between the junctional epithelium and the margin of the bone crest and the distance between the notch and the gingival margin were assessed. In addition, the size of the infiltrated connective tissue was calculated using a morphometric test system.

The results of the experiment revealed that the placement of a "restoration" in a subgingival position in gingival sites also allowed to accumulate plaque established conditions which promoted development of moderate to severe gingival inflammation. In experimental sites characterized by the presence of an "inadequate" width of the keratinized gingiva, the inflammatory reaction was almost always accompanied by loss of gingival tissue. It is suggested that the placement of restorations in a subgingival position in sites with a narrow zone or lacking keratinized gingiva may in the presence of subgingival plaque favour the apical displacement of the soft tissue margin.

Kathy J et al.[182] did a study in 1987 to evaluate the periodontal condition of teeth having submarginal restorations associated with either narrow or wide zones of keratinized gingiva.

58 teeth in 26 individuals were selected and then divided into two groups according to the width of the keratinized gingiva at the midfacial aspect of the tested tooth. Group I consisted of 30 teeth with ≥ 2.0 mm, and Group II consisted of 28 teeth with < 2.0 mm of keratinized gingiva. Each group was equally subdivided into subgroup "A" having teeth with a full coverage, subgingival type of restoration for at least 2 years, and subgroup "B" representing contralateral homologous teeth, in the same individual, with no subgingival restoration. Clinical examination of individual teeth included determination of plaque and gingival indices, gingival fluid, probing depth, bleeding tendency and bone level. Data were subjected to statistical analysis using the Student t test and a two-way analysis of variance to determine any significant differences in variables between teeth with and without subgingival restorations, in narrow and wide zones of keratinized gingiva. The findings were:

1. Teeth with subgingival restorations and narrow zones of keratinized gingiva showed statistically significant higher gingival scores than teeth having submarginal restorations with wide zones of keratinized gingiva.
2. Teeth without subgingival restorations showed no statistical difference between narrow and wide zones of keratinized gingiva ($P > 0.05$).

A critical review of the literature on the periodontal considerations in removable partial denture (RPD) treatment is presented in the article given by Petridis et al.[183] in 2001. A medline search was conducted for studies pertaining to the effects of RPDs on the periodontal tissues during the various phases of prosthetic treatment. The review included both in vivo and in vitro studies. The use of RPDs leads to detrimental qualitative and quantitative changes in plaque. There seems to be a lack of information regarding the effects of RPDs on the status of periodontally compromised abutments. A number of studies, mainly in vitro, have failed to agree on the ideal RPD design. Clinical trials have shown that if basic principles of RPD design are followed (rigid major connectors, simple design, proper base adaptation), periodontal health of the remaining dentition can be maintained. It was concluded that removable partial dentures do not cause any adverse periodontal reactions, provided that pre-prosthetic periodontal health has been established and maintained with meticulous oral hygiene.

Frequent hygiene recalls and prosthetic maintenance are essential tools to achieve a good long-term prognosis. More prospective clinical trials are needed on the effect of RPDs on the condition of periodontally involved abutment teeth.

Supportive Periodontal Therapy in Orthodontic Patients

The effects of orthodontic treatment on periodontal tissues in patients with severely reduced periodontal support were studied by Lars-Åke Eliasson et al.[188] in 1982. A prerequisite for tooth movement was a reduction of periodontal inflammation by regular scaling and a high standard of oral hygiene. Surgical elimination of deepened periodontal pockets was not performed before orthodontic tooth movement. 20 patients took part in the study. The reduction of maxillary overjet was performed with light forces by elastics from removable orthodontic appliances. Oral hygiene, gingival inflammation, pocket depth and the alveolar bone level were recorded before hygiene treatment and before and after orthodontic treatment.

As a result of the hygiene treatment, the plaque index and gingival index scores were markedly reduced. The values for pocket depth showed no major change. When comparing mean values for proximal bone level measurements before and after orthodontic tooth movement no difference could be seen. The individual proximal bone level values remained unchanged for every second surface. The maximum deterioration in bone level, measured as a percentage of tooth length, during orthodontic treatment was 10% in 9 surfaces out of 142.

Provided careful pre-orthodontic hygiene treatment of the existing advanced periodontal disease is given and the forces are kept within physiological limits, the results from this clinical study show that no increased progression of marginal periodontitis will occur due to orthodontic tooth movement.

Wennström JL et al.[190] in 1993 evaluated the effect of orthodontic tooth movement on the level of the connective tissue attachment in sites with infrabony pockets. The experiment was carried out in 4 beagle dogs. The second and fourth premolars were extracted. After healing, angular bony defects were prepared at the mesial aspect of the third premolars. The exposed root surface was scaled and planed, and a notch was prepared at the bottom of the defect. Plaque-collecting cotton floss ligatures were placed around the neck of the teeth and maintained in situ for 3 weeks, followed by an additional 2 months of plaque accumulation before the orthodontic tooth movement was initiated. In each dog, one premolar was moved away from the angular bony defect and one premolar into and through the angular bony defect. The maxillary third premolars served as control teeth and were not subjected to orthodontic tooth movement. After orthodontic treatment (5 to 6 months), the teeth were stabilized for a period of 2 months before biopsy sampling. Clinical, radiographic, and histologic evaluations revealed that is was possible to establish and maintain an infrabony pocket with a subcrestal, plaque-induced inflammatory lesion during the entire course of the study. While the control teeth had maintained their attachment levels, all but one of the

orthodontically moved teeth showed additional loss of attachment. It was concluded that orthodontic therapy involving bodily tooth movement may enhance the rate of destruction of the connective tissue attachment at teeth with inflamed, infrabony pockets and that the risk for additional attachment loss is particularly evident when the tooth is moved into the infrabony pocket.

Two groups of 20 adolescents, one treated and one untreated were followed longitudinally for 5 years by Bondemark L. et al.[192] in 1998. The interdental alveolar bone level was estimated as the distance between the cementoenamel junction and the alveolar bone crest on bitewing radiographs of the upper and lower premolars and molars on three occasions, the first at the start of treatment, the second after 2.8 years, and the third at the end of the 5-year study period. Between the first and second examination, the subjects in the treatment group were orthodontically treated in the upper arch with magnets and super-elastic coils succeeded by straight-wire appliances in both arches. At the start of this study, no significant difference in alveolar bone level between treated and untreated groups was found. It was demonstrated that there was a small but significant decrease in interdental alveolar bone support ranging between 0.1 and 0.5 mm during the 5-year observation period both in the treated and untreated group. Neither group had any sites with clinically significant bone loss i.e. a distance > 2 mm between the cementoenamel junction and the alveolar bone crest. The treated group exhibited a statistically significantly larger increase of cementoenamel junction and the alveolar bone crest distance at the mesial surfaces of the first and second maxillary molars than did the untreated group. This was thought to be a direct consequence of the orthodontic treatment, either as a result of band placement, tipping, or extrusive effects, or due to tooth morphology leading to plaque accumulation.

Stefania et al.[189] in 2000 evaluated the effectiveness of surgical and non-surgical periodontal therapy in the maintenance of a healthy periodontal status after the orthodontic treatment. Surgical periodontal treatment was performed in 267 patients affected by severe periodontal disease, and 128 patients had non-surgical treatment. For each patient the mean value of probing depth (mPPD) and the rate of positive bleeding on probing (%BOP) of the teeth involved in the orthodontic movement were registered before the start of the periodontal treatment, at the end of the orthodontic treatment, and 2, 4, 6, 10, and 12 years after the end of the orthodontic treatment. Comparison between pretreatment and post-treatment values and between pretreatment and follow-up values showed a decrease in mPPD and %BOP that was of statistical significance. The difference between post-treatment and follow-up values was not statistically significant. These results suggest that orthodontic treatment is no longer a contraindication in the therapy of severe adult periodontitis. In these cases orthodontics improve the possibilities of saving and restoring a deteriorated dentition.

Bollen AM et al.[191] in 2008 did a systematic review was to compare contemporary orthodontic treatment with no intervention, by means of evaluating periodontal

outcomes measured after end of treatment. Electronic searches in eight databases (1980-2006) and hand searches in six dental journals (1980-2006) were done. This systematic review identified an absence of reliable evidence describing positive effects of orthodontic treatment on periodontal health. The existing evidence suggests that orthodontic therapy results in small detrimental effects to the periodontium.

A longitudinal trial split-mouth study was done by Jan Van Gastel et al.[187] in 2008 included 24 patients. Microbiology (sub and supragingival), probing depth (PD), bleeding on probing (BOP), and gingival crevicular fluid flow (GCF) were assessed at baseline (band placement) and at week 18 (bracket bonding) 20, 24, and 36. A statistical comparison was made over time and among the banded, bonded, and control sites.

The aerobe/anaerobe ratio of sub and supragingival colony forming units decreased significantly (relatively more anaerobes) over the study period for the banded and bonded sites ($P < 0.001$). This decrease was accompanied by significant elevations in PD, BOP, and GCF. These changes occurred faster after bonding compared to banding. No significant changes were observed 18 weeks after banding with the exception of increased PD ($P < 0.001$). At week 36, all microbial and clinical variables at the bonded site had changed significantly in the negative direction ($P < 0.001$) compared to week 18. The control sites did not show any significant changes over time, indicating that the effects were localized. It was concluded that the placement of fixed orthodontic appliances had a significant impact on microbial and clinical variables. The changes occurred faster at the bonded sites compared to the banded sites, probably because wire insertion caused difficulties in approximal cleaning. Over the long-term, banding did not lead to more adverse microbial and periodontal effects than bonding.

Supportive Periodontal Therapy in Patients on Radiation Therapy

Tah Yee Chen et al.[195] in 1974 conducted a study where, One hundred one cases of head and neck cancer were subjected to oral culture for candida albicans before, during, and 1 month after radiotherapy. 30% of the patients had a positive culture before radiotherapy. During the course of radiotherapy, almost half of the negative patients turned positive. The severity of the acute radiation reaction of the oropharyngeal mucosa was not related to the apparent presence or absence of candida albicans. Amphotericin B (1 cm3 [100 mg] q.i.d.) converted about one-third of the positive patients to negative. However, only 1 of these converted patients showed some clinical improvement of the acute radiation reaction. It would appear that sterilization of the oral cavity with this fungicide during radiotherapy in patients with head and neck cancer is not justified.

Joel B Epstein et al.[193] in 1998 did a study to determine the potential impact of head and neck radiation therapy on the progression of periodontal attachment loss.

Ten patients who received unilateral radiation fields that included the dentition were assessed before radiation treatment and after irradiation at a mean age of 6.01

years. Complete oral, dental, and periodontal examinations were completed by one examiner. The results were assessed through use of paired t tests.

More teeth were extracted because of periodontal disease in the field of radiation after irradiation. Remaining teeth in the radiated volume showed an increase in probing depth of 0.82 mm in comparison with 0.40 mm for teeth in the non-radiated region (P=0.05). Recession on the facial aspects was 1.88 mm for teeth in the radiated volume and 1.16 mm for teeth in the non-radiated region (P=0.001), and recession on the lingual aspects was 2.10 for teeth in the radiated volume and 0.91 for teeth in the non-radiated region (P =0.05). Mean total attachment loss was 2.81 mm for teeth in the radiated sites; this compared with 1.43 mm for teeth in the non-radiated sites (P=0.003). Increased mobility of teeth in the high-dose fields was seen (P=0.02). This study showed that tooth loss and greater periodontal attachment loss occur in teeth that are included within high-dose radiated sites of patients treated with irradiation therapy for cancer.

Supportive Periodontal Therapy for Chemotherapy Patients

Rabbani et al.[202] in 1981 did a study to evaluate the effectiveness of subgingival scaling and root planing related to depth of pocket and type of teeth. A total of 119 teeth in 25 patients were selected; 62 were scaled and 57 were used as controls. All teeth were initially scored using the calculus index of the P.D.I. (Ramfjord). Six surface locations were probed to determine pocket depth. The levels of the gingival margin were marked on the teeth to locate supra and subgingival calculus after extraction. The experimental teeth then were scaled. Both scaled and unsealed teeth were extracted immediately after the experimental procedures. The teeth were washed with water and stained with methylene blue. They were viewed under a stereo-microscope which had a tenth grid on its eyepiece. Percent of surface covered by calculus was assessed on both scaled and unsealed teeth. The results demonstrated a high correlation between percent of residual calculus and pocket depth. It was shown that pockets less than 3 mm were the easiest sites for scaling and root planing. Pocket depths between 3 to 5 mm were more difficult to scale and pockets deeper than 5 mm were the most difficult. Tooth type did not influence the results.

Haffajee et al.[200] in 1983 did a study to evaluate the usefulness of clinical measurements of periodontal disease in predicting destructive periodontal disease activity. Periodontal status was monitored at 3414 sites in a total of 22 subjects. Repeat attachment level measurements recorded at 2-month intervals were analysed by the tolerance method to detect destructive periodontal disease activity. The number of sites that showed or did not show activity and the absence or presence of a clinical parameter before and after the monitoring period were computed. The diagnostic sensitivity of a clinical parameter in predicting disease was expressed as the proportion of sites showing attachment loss which exhibited that parameter. Diagnostic specificity

was expressed as the proportion of sites not exhibiting the clinical parameter and not showing attachment loss. In addition, the probability of false positive and false negative diagnoses were computed, using the assumption that the destructive periodontal disease activity rate of sites at risk was 3%.

The sensitivity of clinical measurements of gingival redness, plaque, suppuration and bleeding on probing ranged from 0.03 (suppuration) to 0.42 (plaque). Specificity of these measurements was better, ranging from 0.71 for plaque to 0.97 for suppuration. Disease activity was most often associated with shallow pockets, but shallow pockets by far dominated she-sites at risk. Thus; pocket-depth: of < 4 mm was a sensitive diagnostic test for disease activity (0.69), but the measured specificity of 0.25 indicated that it would be a poor predictor of disease activity. Molar teeth and interproximal surfaces were more likely sites of disease activity than other teeth or surfaces with sensitivity values of 0.52 and 0.83, and specificity values of 0.28 and 0.34, respectively. The probability of detecting false positives was high using any of the clinical parameters ranging from 0.95-0.97. Because no clinical parameter demonstrated high sensitivity and high specificity values, none of the clinical parameters used individually or in combination were found useful in predicting disease activity at individual sites.

Hunter et al.[203] in 1984 did a study to determine if, with an open flap approach, ultrasonic or hand instrumentation could remove all calculus from previously untreated teeth with moderate to severe loss of attachment. To be included in the study, teeth had to have at least 5 mm of attachment loss, be scheduled for extraction and be graded 2 or 3 on the calculus index of the periodontal disease index system. Under local anaesthesia, full thickness, envelope type flaps were elevated apical to the crest of bone to allow access to the root surfaces which were then treated with hand or ultrasonic instrumentation until the roots felt hard and smooth to a Hartzell explorer. The teeth were then removed, rinsed, and lightly scrubbed to remove debris and a No. 14 wheel bur was used to place a groove along the coronal extent of the connective tissue attachment. A stereo-microscope at magnification x 4.6 was used to quantitate the percentage of residual calculus on 25 teeth treated by each method. Overall, hand-scaled root surfaces demonstrated less residual calculus (5.78%) than ultrasonically treated surfaces (6.17%). 20 teeth treated by each method were then prepared for histologic evaluation and evaluated under the light microscope at magnification x 100 for residual calculus and relative smoothness. Residual calculus was found on four ultrasonically and 12 hand-treated teeth and was almost evenly distributed between anterior and posterior teeth for both methods. The finding of considerably less calculus on histologic than on stereo-microscopic examination may have been due to the loosening of deposits by instrumentation, especially ultrasonic vibration, and their subsequent release during histologic preparation.

Among the hand-scaled teeth, of 244 surfaces evaluated 138 (56.6%) were considered smooth, and 106 (43.4%) were graded rough. Among the ultrasonically

scaled teeth, of 256 surfaces evaluated, 48 (18.8%) were smooth and 208 (81.2%) were rough.

Caffesse et al.[201] in 1986 did a study to evaluate the effectiveness of scaling relative to calculus removal following reflection of a periodontal flap. Each of 21 patients who required multiple extractions had 2 teeth scaled, 2 teeth scaled following the reflection of a periodontal flap, and 2 teeth serve as controls. Local anaesthesia was used. Following extraction, the % of subgingival tooth surfaces free of calculus was determined using the method described by Rabbani with a stereo-microscope. Results showed that while scaling only (SO) and scaling with a flap (SF) increased the % of root surface without calculus, scaling following the reflection of a flap aided calculus removal in pockets 4 mm and deeper. Comparison of SO versus SF at various pocket depths for % of tooth surfaces completely free of calculus showed 1 to 3 mm pockets to be 86% versus 86%, 4 to 6 mm pockets to be 43% versus 76% and > 6 mm pockets to be 32% versus 50%. The extent of residual calculus was directly related to pocket depth, was greater following scaling only, and was greatest at the CEJ or in association with grooves, fossae or furcations. No differences were noted between anterior and posterior teeth or between different tooth surfaces.

Complications of Supportive Periodontal Therapy

Ravald N et al.[209] in 1993 did a study to know about the individual susceptibility to root caries in periodontally treated patients in a long-term follow-up of 12 years. Age, plaque score, salivary counts of lactobacilli and mutans streptococci, salivary secretion rate and buffer effect, oral sugar clearance time and dietary habit index were tested as possible predictors for root caries incidence. During the whole observation period of 12 years, new root caries lesions were recorded in 24 of a total of 27 patients. In 8 of these, the root caries incidence was between 1 and 5, in 7 between 6 and 9 and in 9, 12 or more new DPS. However, the annual mean number of new DPS was rather low. 13 patients with > 5 new DFS% during the 3rd 4-year period (years 9-12) differed significantly from 14 patients with 5 new DFS% in salivary mutans streptococcus counts ($p < 0.001$), plaque scores ($p < 0.001$) and new DFS% during the 2nd 4-year period (years 5-8) ($p < 0.001$). Simultaneously, risk values among the variables tested at the 8-year examination were about 3x more prevalent in patients that developed > 5 new DFS% in years 9-12 than in those with 5 new DFS%. During the whole 12-year observation period, smokers had significantly more root caries than non-smokers ($p < 0.05$). The main conclusions from this study are:

1. That root caries in this category of periodontally treated patients is a minor problem although some individuals show a high incidence, and
2. That patients at risk for development of root caries may be possible to identify by using readily available tests in addition to clinical examination and the patient's medical history.

Basten et al.[212] in 1996 did a study where 32 consecutively treated patients were included. The patients had 49 root-resected molars that were under regular recall of 3 to 6 months for a mean of 11.5 years (2 to 23 years). Treatment modalities for all patients were very similar. Endodontic treatment was conservatively performed prior to resection with maximum preservation of tooth structure. No threaded posts were used. Provisional restorations were in place prior to periodontal therapy (pocket reduction with or without osseous surgery). Most patients were treated with complete-mouth reconstructions. 92% of all resected molars survived an average of 12 years. Teeth failed because of recurrent caries or for endodontic and strategic reasons. If proper treatment is rendered, periodontically involved motors can be maintained for a long period of time and serve successfully as abutments in complete-mouth restorations. Great care must be taken throughout the whole process of case selection, re-evaluation, and endodontic, periodontal, restorative, and maintenance therapies.

Farina et al.[206] in 1997 did a study to determine (i) the long-term disease recurrence in intraosseous defects that had undergone an open flap debridement (OFD) procedure with or without enamel matrix derivative (EMD); and (ii) whether and to what extent clinical changes recorded on teeth treated with surgery were similar at sites involved or adjacent to the intraosseous defect. 11 patients contributing twelve reconstructed intraosseous defects were retrospectively recruited and included for analysis. Immediately before surgery, at 12 months post-surgery and at long-term examination (6-8 years post-surgery), probing pocket depth (PPD) and clinical attachment level (CAL) were recorded at the test site (representative of the reconstructed intraosseous defect) and the control site (representative of an adjacent non-reconstructed site) of each tooth treated with surgery. All patients received monthly professional maintenance up to 12 months after surgery, and every 6 months or less frequently thereafter. In test sites, CAL varied from 5.4±0.8 mm at 12 months to 6.5±1.0 mm at the long-term examination. PPD increased from 3.7±0.4 mm at 12 months to 4.3±0.6 mm at the long-term examination, the changes being not statistically significant. When PPD and CAL changes from 12 months to the long-term examination were compared between test and control sites, no significant differences were found.

Within its limitations and considering the limited sample size, the present study indicates that (i) the attachment gain that has been achieved by means of a surgical re-constructive procedure (based on OFD with/without EMD) may be mostly maintained over a 6-8 year follow-up period; and (ii) the extent of disease recurrence, as assessed by attachment loss and pocket deepening, was similar at sites involved or adjacent to the intraosseous defect.

Tonetti et al.[207] in 2001 did a retrospective survey to determine the prevalence of tooth extractions and the dental pathologies associated with them during both the active and maintenance phase of periodontal therapy in a periodontal population seeking comprehensive dental care. A total of 273 randomly selected subjects from the oral prophylaxis clinic of the University of Berne were included. All subjects had

received comprehensive care consisting of periodontal and restorative treatment and participated in a supervised maintenance program for an average of 67±46 months (range 5 to 278 months). The population consisted of 39.6% current smokers and 27.8% previous smokers. 6.2% of the patients had gingivitis, 20.5% mild periodontitis, 48.4% moderate, and 24.9% severe periodontitis. The average frequency of the recall visits was 4.4±1.5 appointments/year (range 1.7-12 appointments/year). Results indicated that 574 out of a total of 6503 teeth were extracted; 311 teeth were extracted during active therapy and 263 during the supportive periodontal care (SPC) phase of therapy. 46% of patients received tooth extractions as part of their active treatment and 41% during their participation in the secondary prevention program. In the subgroup whose treatment plan included extractions the average number was 2.5±1.6 teeth per patient. Likewise, the patients who received extractions during recall lost an average of 2.35±1.9 teeth per subject with an incidence of 0.4±0.37 teeth per patient per year. These data reinforce the concept that a minority of the population is responsible for the majority of tooth extractions, both during active therapy and SPC. Periodontal disease was the only pathology observed at 57% of the extracted teeth; while caries, endodontic pathology and technical problems in the absence of periodontitis were observed in 29% of cases.

These observations indicate that the rendered treatment was effective in the long-term maintenance of the dentition of these subjects and suggest that advanced periodontal disease represented the major cause of tooth loss in this population.

Bleeding on probing and the presence of deep periodontal pockets are considered to be the best site-specific indicators for periodontal disease progression during the maintenance phase of periodontal therapy. A major emphasis of supportive periodontal care (SPC) programs, therefore, has been the control of bleeding pockets. Tonetti et al.[208] in 2005, retrospectively evaluated the changes in the prevalence of bleeding on probing, periodontal pockets, bleeding periodontal pockets and the prevalence of tooth loss in a random sample of 273 periodontal patients participating in a supportive maintenance care program at a University Clinic. During an observation period of 67±46 months (range 5 months to 23 years), the overall incidence of all causes of tooth mortality was 0.23±0.49 teeth per patient per year of observation. 56% of subjects, however, did not experience any tooth loss, while less than 10% of patients lost more than 3 teeth. Thus, participation in the SPC program was effective in preventing tooth loss in the majority of patients. During the SPC period, however, a significant increase in the prevalence of periodontal pockets, and of bleeding on probing positive periodontal pockets, in particular, was observed. At completion of active periodontal therapy. 56.4% of patients were free from bleeding pockets. This decreased to a mere 13.6% at the latest SPC evaluation. The observed increases in the number of bleeding pockets was significantly associated with: longer times since completion of active periodontal therapy, more advanced periodontal diagnosis, higher percentage of bleeding sites in the dentition, cigarette smoking, lack of inclusion of periodontal surgery in the

active treatment phase, tooth loss, and the response to the active phase of periodontal treatment. The data presented in the paper indicate that the observed increase in the prevalence of bleeding pockets and tooth loss was not homogeneously distributed in the studied SPC population. Better knowledge of risk indicators may lead to improved and more efficient risk management efforts during periodontal maintenance care.

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Supportive Periodontal Therapy
A Comprehensive Review

About The Book

Supportive periodontal therapy has been considered as the cornerstone of successful periodontal therapy. The successful management of the periodontal disease requires a positive program directed at maintaining and improving the results of treatment as well as preventing the development of the new disease. Hence, in this book, we have presented insightful evidence that has been accumulated about the effectiveness of periodontal therapy.

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