

The Clinical Protocol Is What Really Counts – PTC, SPT and GBT

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Keywords

Axelsson and Lindhe's recall session, professional tooth cleaning, PTC, supportive periodontal therapy, SPT, Guided Biofilm Therapy, GBT

Abstract

To achieve the objectives of primary, secondary, and tertiary prevention, a well-structured approach is needed. All clinical protocols practised today rest on the two pillars of successful prophylaxis (at-home and professional oral hygiene) and the recall session developed by Axelsson and Lindhe 50 years ago. New scientific insights into the causes of oral diseases and technological progress require adjustments of tools and clinical protocols. This article compares both the tools used for biofilm management and the four clinical protocols currently available, i.e., recall session, professional tooth cleaning (PTC), supportive periodontal therapy (SPT) and Guided Biofilm Therapy (GBT).

Introduction

The oral diseases caries and periodontitis are among the most common diseases worldwide^{22,33}. Both have multifactorial causes. Primarily, however, they are biofilm-induced diseases of hard and/or soft oral tissues. Today, the ecological plaque hypothesis by *Marsh*²⁵ is accepted worldwide as the aetiology: A vital, dysbiotic, sub- and supragingival biofilm causes the most prevalent oral diseases.

Since the causes of these diseases are largely known, cause-specific prevention is possible. The top priority of oral medicine is to keep a patient's natural teeth and periodontium healthy, functionally acceptable, and pain-free throughout that patient's lifetime¹³. Or as *Axelsson* and *Lindhe*¹⁻⁵ put it in their ground-breaking works: "Lifelong oral health is achievable. If the objective of oral healthcare is to preserve natural teeth for life, then the loss of a tooth

is the ultimate failure." The present-day prophylaxis concepts, which have all been derived from the works of *Axelsson* and *Lindhe*, rest on two pillars: at-home and professional oral hygiene (Fig. 1). All clinical protocols of systematic prophylaxis sessions have also been derived from the works of *Axelsson* and *Lindhe* or their recall session (Fig. 2). However, *Axelsson* and *Lindhe* began their work in the early 1970s. New clinical protocols of prophylaxis sessions need to take the scientific and technological progress of the last 50 years into account. New aetiological insights require new aims and tools. In the past, the focus was on hard deposit removal with hand instruments; today, it is on biofilm management, minimal invasiveness, patient, and operator comfort. These new aims and tools require changes in clinical protocols.

In the last few decades, more and more data have indicated that oral prophylaxis matters not only to

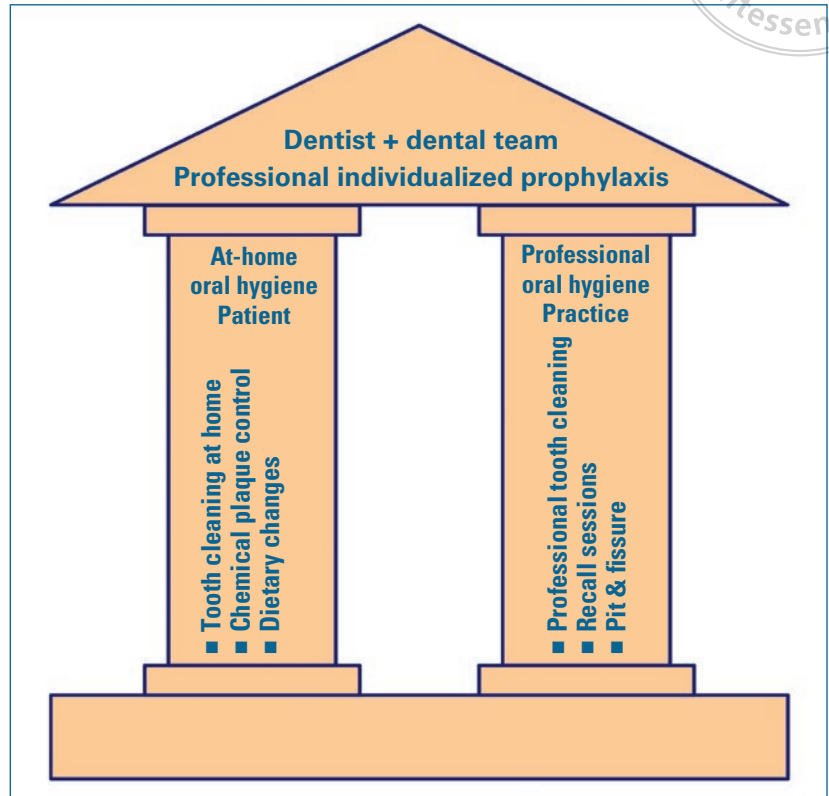


Fig. 1 Axelsson and Lindhe's pillars of prophylaxis^{1,2}

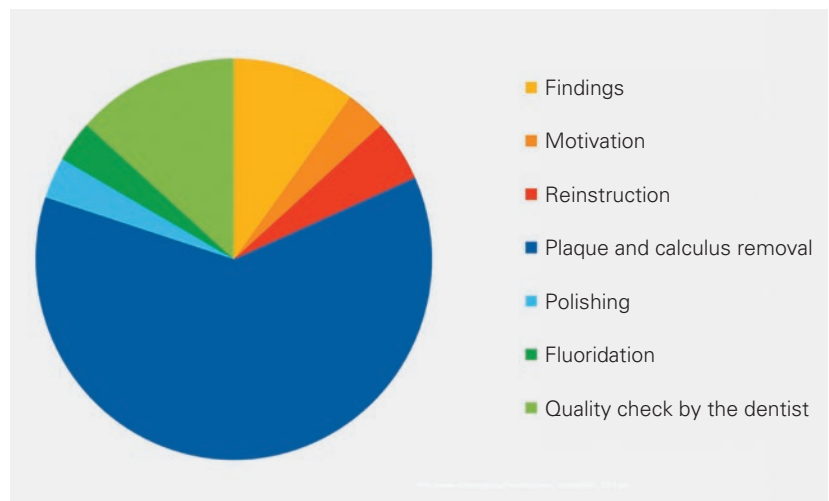


Fig. 2 Axelsson and Lindhe's recall session³

oral health, but also to general health. The influence of oral inflammations on general health is becoming increasingly apparent. Although numerous details have not been understood to date, it is generally accepted that long-term bacterial exposure in conjunction with extensively inflamed and functionally impaired tissues systemically influences general health⁴⁰.

This statement is based on two crucial insights: On the one hand, various clinical studies show that periodontitis, for instance, is associated with diabetes mellitus, cardiovascular diseases, nosocomial lung infections, certain cancer types and rheumatoid arthritis. On the other hand, the oral system is therefore the first line of defence of our immune system; this has been made particularly clear by the current



COVID-19 pandemic. Not the isolated perspective of dentistry, but the interdisciplinary understanding of oral medicine allows us to see connections between oral and systemic health by expanding our knowledge of cellular, bacterial, viral, and functional interactions with the human organism.

Scientific Insights and Technological Progress

In previous centuries, periodontal treatments focused on the removal of what was believed to cause periodontal disease: sub- and supragingival calculus, infected soft tissues, and “infected” cementum. New insights into the importance of the biofilm and the body’s reactions to the biofilm metabolism have shifted the therapeutic focus to biofilm management. And the increasing knowledge of aetiological factors has logically led to new objectives in state-of-the-art initial and maintenance therapy. These objectives are:

- Regular biofilm disruption or removal, establishment of durable homeostasis and inflammation control,
- Conservation of hard and soft tissues (minimal invasiveness) and
- Maximal patient and operator comfort.

The tools available should meet the above requirements. The current literature on the different tools used for biofilm management (scalers, curettes, contra-angle handpieces with rubber polishers, brushes and polishing pastes, air scalers, magnetostrictive and piezoelectric ultrasonic systems and Airflow technology) can be summarized as follows:

Cleaning Efficiency

Traditional rubber cup polishing (RCP) only incompletely removes the biofilm from pits and fissures, implants, interproximal surfaces, crowded teeth, sulci, and especially fixed orthodontic appliances. For exposed cervical areas, RCP is too abrasive, and it cannot remove the biofilm in subgingival areas. *Haas et al.*¹⁹ showed in a comparative investigation of sub- and supragingival tooth cleaning with hand instruments, ultrasonic and Airflow (AF)

systems, RCP, and various combinations of these tools that the best in-depth cleaning of enamel, dentin and cementum is achieved using only AF. *Frankenhauser*¹⁷ compared the results of supragingival biofilm removal with RCP (Cleanic) and AF (erythritol powder) in her thesis. The plaque indices determined after the use of RCP and AF differed significantly ($p = 0.00001$). AF showed better cleaning results. This applied to both anterior and posterior teeth.

*Wennström et al.*³⁹ compared traditional quadrant scaling and root planing (SRP) in four sessions with single-session full-mouth piezoelectric ultrasonic scaling (single-Fm-PUS) with Piezon Master in initial therapy. The clinical results were largely identical. But in the single-Fm-PUS group, treatments were 3 times shorter, 2.5 times less anaesthetics were used, and patient comfort was much higher.

Petersilka et al.^{31,32} showed that the use of AF with a low abrasive powder (glycine) leads to a significantly greater reduction of the subgingival bacterial load, as compared to hand instrumentation.

*Müller et al.*²⁷ proved that the use of the AF and Perioflow technology with a low abrasive powder (erythritol) for residual pockets ≥ 4 mm in depth in maintenance therapy is superior to ultrasonic instrumentation. Clinical parameters and bacterial counts were in the same range, except for significantly lower values for AF in the case of *Aggregatibacter actinomycetemcomitans*. However, AF was much less painful, so the patients preferred AF to ultrasonic instruments.

*Hägi et al.*²⁰ compared hand instrumentation, PUS and AF (erythritol powder) in an in-vitro investigation. The highest reduction of bacterial load was achieved with AF, followed by PUS. Curettes showed the lowest reduction. PUS and AF led to a better attachment of periodontal ligament fibroblasts, as compared to hand instrumentation²⁰.

Minimal Invasiveness

*Flemmig et al.*¹⁶ postulated that a cementum/dentin loss of more than 0.5 mm over a short period of ten years in maintenance therapy is already unacceptable. This means that no more than 0.05 mm (50 μm) per year or 12.5 μm per session, based on



four sessions per year, should be removed in the maintenance phase.

*Ritz et al.*³⁴ proved as early as 1991 that these values cannot be achieved with air scalers, curettes or diamonds and are hard to achieve with ultrasonic instruments.

*Rupf et al.*³⁵ compared the use of curettes, magnetostrictive ultrasonic scalers (MUS) and PUS for calculus removal. PUS was gentlest on the tooth structure, but its cleaning efficiency was slightly lower. The clinical parameters were the same in all groups.

*Bozbay et al.*⁷ conducted a comparative in-vivo investigation (curettes, PUS, PUS + AF, AF), which showed the residual cementum in the coronal region of the root to be 65 % for curettes, 84 % for PUS, 80 % for PUS + AF and 94 % for AF.

*Hägi et al.*²⁰ also compared hand instrumentation, PUS and AF (erythritol powder) regarding substance loss and surface roughness in their in-vitro investigation. Curettes showed the highest substance loss, followed by PUS and AF with erythritol. The surface roughness (Ra) values found after the use of curettes were significantly higher, as compared to PUS and AF with erythritol.

*Petersilka et al.*³⁰ compared curettes, PUS and AF with erythritol or glycine powder regarding soft tissue injuries. AF caused the least gingival injuries with either powder, followed by PUS. Curettes showed considerable gingival injuries.

*Barnes et al.*⁶ compared various powders used in the AF technology in terms of minimal invasiveness (enamel, composite, glass ionomer cement). Glycine and erythritol did not damage enamel, composite, or glass ionomer cement (defect depth and volume), unlike other powders (sodium bicarbonate, aluminium oxide, calcium sodium phosphosilicate, calcium carbonate).

Patient Comfort

*Wennström et al.*³⁹ and *Müller et al.*²⁷ showed in their studies AF with low abrasive powders to be clearly superior to hand and ultrasonic instrumentation regarding patient comfort.

*Wennström et al.*³⁸ compared PUS and AF with low abrasive powders in maintenance therapy. The

clinical and microbial values did not differ, but patient comfort was much higher in the AF group.

*Bühler et al.*⁸ concluded in a systematic review that pain and paraesthesia experienced in nonsurgical periodontal therapy are lower when using AF, as compared to ultrasonic and hand instruments.

Operator Comfort

*Lalumandier et al.*²⁴ found in their study the highest prevalence of hand problems and carpal tunnel syndrome (CTS) among dental hygienists, as compared to all other dental professionals.

*Graetz et al.*¹⁸ showed the risk of work-related wrist overload to increase when the wrist is flexed or extended by more than 46°. The wrist is turned to a significantly lesser extent when using ultrasonic or air scalers, as compared to hand instruments, so the former tools are gentler on the wrist.

Axelsson and Lindhe's Recall Session

The key elements of the works of *Axelsson* and *Lindhe*^{1,2} were these: Prophylaxis needs a consistent philosophy or vision. Initial periodontal and caries therapy and subsequent maintenance therapy should be standardized, systematic procedures; maintenance therapy should be performed only by suitably qualified professionals; initial and maintenance therapies performed should be scrutinized (check of the results); and patients should regularly return for prophylaxis (recall session).

The idea of regular recall sessions is based on the observation that patient compliance/adherence begins to continuously decrease as soon as the active treatment phase is completed or dental professionals cannot directly influence their patients any longer^{2,23,25}.

Without targeted, thorough, regular recall sessions, treatment successes achieved deteriorate in the course of time. After a period of four or more years, only 20 % to 40 % of all periodontal patients still return for follow-up care^{9,11,23,28,29}. In a study conducted in an Italian periodontal practice, 38 % of the participating patients returned for follow-ups



after one year. After four years, only 20 % still returned for follow-ups⁹. In another study conducted in a periodontal practice, the dropout rate in the first two years was 13.9 %; after six years, 48.4 % still returned for follow-ups; and over the total study period of 14 years, only 27.4 % of the patients remained fully cooperative¹¹.

All of today's clinical protocols for prophylaxis are based on the recall session described by *Axelsson* and *Lindhe*³ (Fig. 2). The session specifies a strict time grid with a standardized workflow. Today, this time and workflow standard should be replaced by an individualized, indication-oriented approach. The tools used for professional tooth cleaning (PTC) as such – *Axelsson* and *Lindhe* called it “active intervention” – including hand instruments (scalars and cures) and contra-angle handpieces, rubber polishers, brushes, and polishing pastes, need to be adapted to scientific insights, focusing on biofilm management, and technological progress regarding cleaning efficiency, minimal invasiveness, patient, and operator comfort.

Professional Tooth Cleaning (PTC)

PTC is not a systematic procedure in prophylaxis. It is part of the systematic recall session and comprises *Axelsson* and *Lindhe's* “active intervention” for plaque or calculus removal and polishing.

PTC is a specific measure taken for primary prevention of caries, gingivitis, and periodontitis, rather than a systematic approach like the recall session, supportive periodontal therapy (SPT) or Guided Biofilm Therapy (GBT). It is an integral part of all clinical protocols. PTC plays a crucial role in a prevention-oriented master plan. However, it is not a measure taken for periodontal therapy! This was reflected in a statement by *Tonetti*³⁷ during a prevention workshop of the European Federation of Periodontology (EFP): “Professional Mechanical Plaque Removal (PMPR) as the sole treatment modality is inappropriate in patients with periodontitis.”

When PTC was included in the German Dental Fee Schedule (GOZ), the confusion around this term became even greater. The GOZ describes this dental service under Item 1040 as follows: “The service

comprises supragingival/gingival deposit removal from tooth and root surfaces, including the cleaning of interdental spaces, biofilm removal, surface polishing and suitable fluoridation measures, per tooth or implant or bridge unit.”

Benefits of PTC: Comment on the Statement by the German Institute for Quality and Efficiency in Health Care (IQWiG)

Since *Axelsson* and *Lindhe* published their controlled clinical studies in the 1980s, it has been clear that a prophylaxis programme based on oral hygiene instructions and PTC can effectively and almost completely prevent both caries and periodontitis^{1,2}. Due to the spectacular results of the prophylaxis group of the study, the responsible ethics commission decided that it had to be discontinued.

Appropriately, the studies included the use of fluorides four to six times per year, in addition to oral hygiene instructions. Their successes highlighted the importance of a combined effect of at-home (instruction, motivation) and professional (PTC) prophylaxis and would not nearly have been achievable without PTC.

Another study with 13- and 14-year-old schoolchildren confirms the importance of PTC⁴. The programme was based on oral hygiene instructions given at 14-day intervals and the use of chlorhexidine gel. Without PTC, there was a substantial increase in caries incidence, ranging from 1.2 to 5.9 new carious lesions per year. With additional PTC, the increase in caries incidence only ranged from 0.3 to 0.5 new lesions per year.

In summary, this means that PTC is a scientifically accepted, highly effective, specific measure taken for prevention¹⁵. It is an integral part of all current systematic prophylaxis protocols.

Supportive Periodontal Therapy (SPT)

SPT is a lifelong concomitant therapy for patients who once developed periodontitis. The results of initial periodontal therapy can only be durably stabilized if patients subsequently undergo long-term SPT (also known as periodontal maintenance

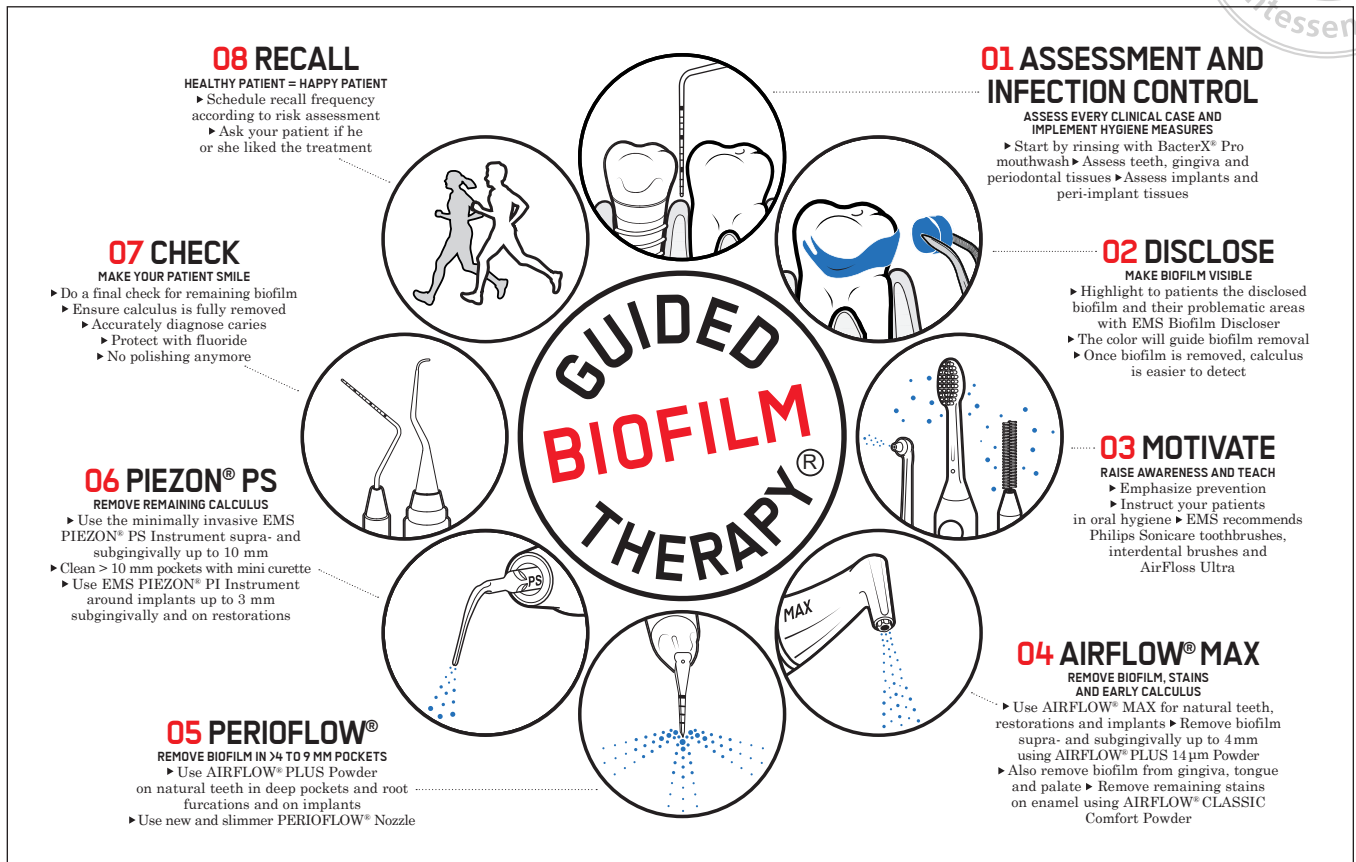


Fig. 3 Guided Biofilm Therapy (GBT) is an evidence-based, indication-orientated, systematic, modular prevention or prophylaxis and therapy protocol for all dental applications.

therapy, PMT). SPT is Step 4 of today's periodontal treatment strategy^{14,21}:

- Step 1: Control of the supragingival biofilm and risk minimization
- Step 2: Subgingival instrumentation (categorically used on all periodontal patients)
- Step 3: Surgical therapy (only used on periodontal patients with residual pathological pockets, e.g., vertical or furcation defects)
- Step 4: SPT

SPT is based on *Axelsson* and *Lindhe's* recall session and uses a strict time grid with a standardized workflow. The clinical protocol of SPT comprises the following steps:

1. Remotivation and reinstruction of the patient to perform oral hygiene at home, and supra- and subgingival professional mechanical plaque removal (PMPR)
2. Polishing

3. Examination and diagnosis
4. Subgingival instrumentation
5. Fluoridation and new appointment

The tools used for SPT include scalers, curettes, contra-angle handpieces with rubber polishers and brushes, polishing pastes, air scalers, MUS and PUS systems, and AF technology.

Guided Biofilm Therapy (GBT)

New technologies and the current state of research, as summarized above by a few excerpts from the literature, require a modification of *Axelsson* and *Lindhe's*¹⁻³ traditional recall session to include the concept of GBT^{10,36} (Fig. 3). This is also reflected in the study by *Haas et al.*¹⁹.

The new objectives set by GBT in addition to effective cleaning are minimal invasiveness and maximal patient and operator comfort.



Fig. 4 Airflow Max handpiece with laminar flow



Fig. 5 Piezon LED PS ultrasonic scaler (EMS, Nyon, Switzerland)

GBT is an indication-oriented, systematic, modular prevention and therapy protocol. It was developed by E.M.S. Electro Medical Systems S.A. (EMS), a Swiss dental manufacturer, and the Swiss Dental Academy (SDA), EMS's centre of continuing education, in cooperation with universities and practitioners.

GBT can be used on both new and maintenance patients. It is universally suitable for healthy patients (prevention) and diseased patients (initial and maintenance therapy for caries, gingivitis, periodontitis, peri-implant mucositis and peri-implantitis). The eight steps or modules of GBT are:

1. Ensure infection control, take the case history (anamnesis), examine the patient, and record the findings
2. Make the biofilm visible with a disclosing solution, determine and record the plaque index
3. Inform, instruct, and motivate the patient to perform oral hygiene at home, make dietary changes and use supportive chemical oral hygiene products
4. Accurately remove the biofilm with the AF handpiece and Plus Powder supragingivally and up to 4 mm subgingivally (Fig. 4)
5. Accurately remove the biofilm with the Perioflow handpiece and Plus Powder between 4 mm and 9 mm subgingivally
6. Accurately remove supra- and subgingival calculus with a PUS (Fig. 5)



7. Check the quality of the treatment; this includes a final diagnosis by the dentist
8. Make an individualized, risk-oriented recall appointment.

Each GBT step has been well-investigated in terms of both the tools and the materials used, and the efficacy of each step is evidence-based, including patient satisfaction^{6-8,16-17,19,20-21,27-28,30-32,34-35,38-39}.

Essentially, the old protocols have been modified in two ways: The supragingival biofilm is always disclosed. And this is followed by “fine cleaning” to remove the supra- and subgingival biofilm and any discolorations with AF and AF Plus Powder and/or Perioflow and Perioflow Plus Powder. Only after these steps will any remaining hard deposits be accurately removed using an ultrasonic system (Piezon No Pain/PS).

Summary

State-of-the-art general and oral medicine is characterized by prevention, personalization, and partnership (“Medicine 3.0”).

Prevention

With the aid of targeted preventive measures, every person can lay the foundations for improved health, fitness, and quality of life.

- Primary prevention aims to preserve a person’s health, i.e., avoid the development of a disease. Measures are taken before any damage, disease or abnormal behaviour occurs, and potential causes and risk factors are assessed. Primary prevention is intended for all healthy people.
- Secondary prevention aims to diagnose a disease early or prevent it from progressing. It serves to detect any damage, disease or abnormal behaviour at an early stage or take care that a disease does not become worse or chronic. Secondary prevention is intended for patients wishing to actively contribute to their recovery.
- Tertiary prevention aims to prevent an already-established disease from progressing or leading to complications. The goal is to detect any damage or abnormal behaviour resulting from a clinically manifest chronic disease at an early stage and

prevent any complication, secondary disorder, deterioration, or recurrence. Tertiary prevention is intended for patients wishing to actively contribute to their recovery or maintain the health status achieved¹².

As the causes of the most common oral diseases, such as caries and periodontitis, are largely known, the focus should be on primary prevention. Consequently, curative oral medicine should be replaced by preventive oral medicine in the long term.

Personalization (Individualization)

Personalized oral medicine means that we offer our patients the type of prophylaxis that is best for them, i.e., individualized, risk-oriented, and age-specific prophylaxis.

Partnership

Partnership of patients and dental teams is the basis on which shared health goals can be achieved. In other words: Prophylaxis can only be successful when patients and team members cooperate.

Of the four clinical protocols described, only GBT is suitable for all three types of prevention. PTC, as a specific measure, is an integral part of all these protocols. *Axelsson* and *Lindhe’s* recall session can be used universally, just like GBT. However, the recall session cannot be adapted to individual oral health requirements as needed, due to its strict time grid and standardized workflow. SPT is solely follow-up care performed after completing an initial periodontal treatment (tertiary prevention).

GBT is based on the latest scientific insights and technological progress. The clinical protocol of GBT is an indication-oriented, systematic, modular prevention and therapy protocol. GBT starts from individualized diagnosis and risk assessment, as a targeted, i.e., “guided”, approach to achieving optimal results in terms of cleaning efficiency, minimal invasiveness, patient, and operator comfort. GBT can be used universally for the prevention and therapy of all biofilm-induced oral diseases. And it is an excellent protocol for achieving the objectives of state-of-the-art oral “Medicine 3.0”.

As such, GBT follows the statement made by Prof Dr *Roland Frankenberger*, President of the German



Society of Dentistry and Oral Medicine (DGZMK) and Editor-in-Chief of the dental journal “Quintessenz Zahnmedizin”, in his July 2020 editorial on the special importance of prevention: “The vision for the future is oral medicine, and prevention is our rescue package.”

Note: For transparency, it should be mentioned that one author of this article (Dr Klaus-Dieter Bastendorf) serves as a speaker for EMS.

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