

The efficiency of dental plaque control measures based on risk prediction, using modern prophylactic methods

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Summary

A fundamental principle for all preventive action is that the positive effect is greatest where the risk for disease is greatest. The effectiveness of plaque control by self-care depends on motivation, knowledge, oral hygiene instruction, oral hygiene aids and manual dexterity. An up-to-date needs-related combination of mechanical and chemical plaque control measures by self-care and professionals is the most efficient method for prevention and control of periodontal diseases as well as dental caries. Key words: plaque control, risk for disease, PFRI (plaque formation rate index), dental hygiene, Prophylflex.

Introduction

As pointed out during the World Workshop in Periodontics (Hancock 1996), the concepts of prevention can be applied at any point during the natural history of a disease.

Preventive measures are subdivided into three broad groups depending on when they are applied during the disease process. The classic application of preventive concepts concerns all efforts taken to prevent a disease from becoming clinically evident. This component of prevention is termed primary prevention. Once the disease is clinically present, the goal of prevention shifts from the prevention of disease occurrence to that of halting the disease progression.

Secondary prevention, as this part of prevention is called, starts early in pathogenesis and is based upon early and accurate diagnostic methods as well as effective therapeutic measures taken to halt and prevent recurrence of the disease. As diseases progress, defects occur, requiring correction to maintain patient's health. Prevention during the stage of corrective therapy has the dual goals of disability limitation as well as rehabilitation, and is named tertiary prevention.

Dental caries is a complex process in which the colonization of the tooth surfaces by bacterial plaque is an essential prerequisite for the development of the disease. Consequently, mechanical

plaque removal could constitute a basic preventive measure. It should be acknowledged that the predilection sites for the development of dental caries, i.e. the interdental surfaces and the pits and fissures, are the most difficult to reach with mechanical plaque control measures. In most studies concerned with the effect of mechanical plaque control on dental caries it is difficult to separate the effects of the mechanical plaque control *per se* and the simultaneous application of fluorides. However, there is evidence supporting the fact that mechanical plaque removal itself decreases the incidence of interdental caries.

There is overwhelming evidence for the direct cause-and effect relationship between the accumulation of supragingival plaque and the development of gingivitis.

Therefore, mechanical plaque control still remains the basic element for the prevention and the treatment of gingivitis.

At present, it is generally accepted that periodontitis characterized by the loss of periodontal attachment is preceded by the presence of gingivitis. In the progression of periodontal disease the subgingival plaque bacteria play an essential role. The subgingival microflora is originally derived from the supragingival dental plaque. Consequently, meticulous mechanical supragingival plaque control can reduce the risk of periodontal attachment loss or its recurrence after therapy.

Aim

The aim of this study is to demonstrate the efficiency of a modern prophylactic method in professional dental hygiene, applied on a risk prediction basis.

Material and method

The amount and location of plaque recorded on clinical examination discloses only where the patient has been unsuccessful in cleaning, despite extra effort on the day of the dental appointment. It does not reveal the age of the plaque, the rate of accumulation, nor the patient's usual standard of oral hygiene. It is therefore important to appreciate the difference between plaque indices, which are static and the plaque reaccumulation rate (PFRI), which is dynamic. An understanding of plaque formation rates and patterns is an essential foundation for successful strategies for primary as well as secondary prevention of dental caries and periodontal diseases.

According to the "non-specific plaque hypothesis", mechanical removal of dental plaque, being causally directed, is a rational method for prevention and control of periodontal diseases and dental caries. For cost-effectiveness, however, it should be related to the pattern of plaque reaccumulation, PFRI, and otherwise predicted risk.

The quantity of plaque which forms on clean tooth surfaces during a given time represents the net results of interactions between etiological factors, many internal and external risk indicators and risk factors, as well as protective factors, such as:

- total oral bacterial population;
- quality of the oral bacterial flora;
- anatomy and surface morphology of the dentition;
- humidity and surface tension of tooth surfaces;
- salivary secretion rate and other properties of saliva;
- intake of fermentable carbohydrates;
- mobility of tongue and lips;
- exposure to chewing forces and food abrasion;
- teeth eruption stage;
- degree of gingival inflammation and volume of gingival exsudates;

- individual oral hygiene habits;
- the use of fluorides and other preventive products, such as chemical plaque control agents.

This observation has been the rationale for the construction of the Plaque Formation Rate Index (PFRI) (Axelsson 1989, 1991). It includes all but the occlusal surfaces and is based on the amount of plaque freely accumulated (*de novo*) in the 24 hours following professional mechanical tooth cleaning (PMTTC), period during which subjects refrain from all oral hygiene.

The following 5-point scale was constructed for the PFRI, based on the percentage of the tooth surface with *de novo* and disclosed plaque:

- score 1 = 1-10% of surfaces affected: very low;
- score 2 = 11-20% of surfaces affected: low;
- score 3 = 21-30% of surfaces affected: moderate;
- score 4 = 31-40% of surfaces affected: high;
- score 5 = > 40% of surfaces affected: very high.

In order to demonstrate the need of a modern prophylactic treatment we took in evidence 139 patients with ages between 6-14 years old, divided randomly in 2 groups: the test group, including 71 patients and the control group, including 68 patients.

At the baseline examination, caries prevalence (DFS), PFRI, Plaque Index O'Leary, Gingival Bleeding Index (GBI) were recorded.

Based on the base line examination, the subjects were groped according to risk, on the basis of the following criteria:

- Low risk groups = PFRI scores 1-2 (test n = 37, control n = 33)
- Risk group = PFRI score 3 (test n = 20, control n = 22)
- High-risk groups = PFRI score 4-5 (test = 14, control = 13).

During the following 2 years the children in the test group received a program of preventive care based on professional mechanical tooth cleaning using Prophyflex – a system which releases a homogeneous water-air-bicarbonate of potassium mixture at the tip of the hand piece just before the emission of the stream.

The efficiency of this system derives from the numerous advantages which it has, as compared to

the conventional methods: it is pain-free, it does not have negative effects on the human body, it can get access in places which are not accessible to usual cleaning systems as the interproximal areas, the spaces between brackets and orthodontic ring – without showing loss of composite or cement. These are due the diffusion of the stream around these elements, thus not needing special installation (it uses a low pressure 35 psi – it allows the adaptation to the dental unit in the place of the turbine), it is small, portable, easy to use, the hand piece is removable, easy to clean, it can be used for tooth bleaching, it is an alternative to the scaling of highly sensitive teeth and the working time is reduced to half.

The dental hygiene applied in the test group was made accordingly to each individual need. The children were very receptive to the prophylactic method that we had chosen and they were recalled every 3 months, this way improving the every day dental care with the help of Prophylflex.

The children in the control group continued to follow the routine: simple preventive program based on oral hygiene instruction, consisting on tooth brushing techniques, dental flossing and topical fluoride administration without any professional prophylactic methods applied in dental office.

Results and discussions

After 2 years, the children in the low risk group had developed significantly fewer new DFS per individual than those in the risk group, who in turn developed significantly fewer new DFS than the high-risk subjects in either control or the test groups.

All the test groups developed fewer new DFS than the control groups. The above study showed that PFRI is a useful tool for evaluation of needs-related plaque control measures. Frequent oral hygiene is more necessary in fast and very fast plaque formers (PFRI scores 4-5) than in slow and very slow plaque formers (PFRI scores 1-2).

In the test group, where we used Prophylflex, the PFRI scores were considerably lower than in the control group, so in the test group the majority was very low (score 1 = 58%) or low (score 2 = 38%).

These results indicated a threshold for caries risk between PFRI score 2 and 3, and this was subsequently confirmed in the longitudinal part of the study. Over the 2 years, subjects with PFRI > score 3 developed 5 times more approximal caries lesions than subjects with PFRI scores of 1-2.

The mean percentage of reaccumulated plaque was at mesiobuccal (MB), distobuccal (DB), mesiolingual (ML), distolingual (DL), buccal (B) and lingual (L) surfaces in the maxillary and mandibular teeth, respectively.

Plaque reaccumulation was greatest on the disto-lingual and mesio-lingual surfaces of the mandibular molars and premolars (> 80%) followed by the distobuccal and mesiobuccal surfaces of the maxillary and mandibular molars (70%).

Almost no plaque reaccumulated on the lingual surfaces of the maxillary teeth, this being probably due to abrasion by the tongue.

Among other observations of the study were:

- Subjects with PFRI scores 4-5 had considerably higher scores for gingival bleeding index than those with scores 1-2.

- An initially high plaque index is usually correlated with PFRI scores 3-5.

- The scores for subjects with very low and low PFRI (scores 1-2) tended to remain constant over the 2-year period, while the scores 3-5 tended to vary, increasing or decreasing by one unit.

Conclusions

During the 2 years of study, the subjects included in the test group to which we applied professional tooth cleaning with the help of Prophylflex developed less dental caries.

Another success was the easy acceptance of the treatment with Prophylflex (being pain-free and using a powder with fruit flavor that was agreeable to children).

The individual tooth brushing practiced by each patient at home was not enough in order to achieve a completely clean mouth, fact that we demonstrated by recording the PFRI index to the test group and also to the control group.

Opposite to conventional methods (manual scaling, ultrasonic scaling), Prophylflex accomplishes hygiene with a high level of accuracy, by

removing the finest tracks of dental plaque and obtaining clean dental surfaces.

The plaque formation rate index (PFRI – Axelsson 1989, 1991) is based on 24-hour *de novo* plaque reaccumulation after professional mechanical tooth cleaning with Prophyflex and should not be confused with plaque indices. Cross-sectional studies have shown a close relationship between plaque reaccumulation, gingivitis and caries prevalence. Longitudinal studies have shown that PFRI is an useful tool for prediction of caries risk and establishment of needs related oral hygiene habits. The highest PFRI values are found on the lingual-approximal surface of the mandibular molars, while the palatal surfaces of the maxillary teeth exhibit the lowest PFRI values.

An optimal program for preventing both caries and periodontal diseases needs an individual risk assessment for the primary development of the disease. Currently, this is not available.

Maximal preventive effects for both diseases have been obtained in long-term clinical trials. The implementation of these programs on a population level may be difficult.

The prerequisite for establishment of needs-related plaque control measures is a well-motivated, well-informed and well-instructed patient as well as behavioral science principles (the “linking method”). Education in self-care and self-diagnosis based on these principles has proven to be efficient in prevention and control of both dental caries and periodontal disease.

Given our present state of knowledge, for the individual patient, it is reasonable to recommend daily meticulous plaque removal using toothbrush with a fluoride toothpaste in combination with interdental cleansing and in the case of a high and very high risk prediction, regulate dental check-ups where the patients can benefit from the modern prophylaxis methods using Prophyflex.

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