Cost-effectiveness of various treatment modalities for adult chronic periodontitis

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The aim of this review was to assess the cost-effectiveness of various modalities for chronic periodontitis in adults. We searched the literature for studies where time consumption and monetary costs (where available) were used as expressions of the resources required to perform the following types of services: providing information on the disease and oral hygiene instruction for patients; removal of subgingival calculus; access surgery; and maintenance and prevention of recurrence of the disease. The following outcome variables were chosen: retention of teeth, or a surrogate variable such as change in bone level measured on X-rays taken at the start and at the end of a 1-year (or longer) period. The literature search did not reveal any studies where these outcome variables could be linked to information on resources used in treatment. Therefore, we reviewed relevant studies where different treatment techniques were used but where the outcome variables were different. This review revealed that in most cases it was difficult to assess whether one type of treatment (or intervention) is more effective than another. We conclude that better data are needed, in particular on outcomes, so that valid comparisons can be made between different types of treatment, for different types of studies.

Periodontal disease is an inflammatory disease induced by bacterial plaque adhering to the tooth surface in contact with the gingiva. A lesion that is contained in the gingival margin is termed gingivitis. Gingivitis may be regarded as the result of an immunologic reaction and as an attempt by the organism to prevent the development of the tissue-destructive component of periodontal disease called periodontitis. Gingivitis will always precede periodontitis, but its development into periodontitis is rare (50). The development of gingivitis into periodontitis is multifactorial and is believed to occur in susceptible individuals where homeostasis is not successfully established by the host. Periodontitis is characterized by the loss of periodontal fibers and alveolar bone, eventually leading to the loss of teeth. The course of the disease and the rate of progression are affected by genetic and environmental factors. These comprise variation in the amount of bacteria (oral hygiene) and their composition in plaque (63), some medical disorders (human immunodeficiency virus, diabetes) and drugs affecting the immune system (steroids, calcium inhibitors) (34). In addition, life-style factors, such as tooth-cleaning habits (58) and tobacco consumption (9), seem to play an important role in determining susceptibility to, and the rate of progression of, the disease. As a result of its chronic character and the fact that the bacteria causing the most common forms of periodontitis are microorganisms that are endogenous in the human oral flora (and probably important for prevention of other infections by exogenous bacteria), periodontitis has a propensity for recurrence after treatment. In fact, the only predictable method to eradicate periodontal disease in a patient is to extract all teeth. However, in spite of this as a treatment option, which would probably be very cost-effective and one that has been considered in special circumstances (17), it will not be considered in this review.

Treatment of periodontitis has been directed towards the changeable risk factors, first and foremost oral hygiene and, in the later years, smoking habits. The professional removal of bacterial plaque from the tooth surfaces is crucial in all forms of periodontal treatment, and training patients in the daily self-removal of plaque is an essential part of prevention of disease recurrence following
treatment (33). The effect of tobacco consumption has become more and more evident over the last few decades (9), particularly concerning the more severe forms of periodontitis (22). Therefore, counseling regarding smoking and other forms of tobacco use has become very important in combating this chronic disease. The treatment of periodontitis thus includes changing life styles for life, because the risk of recurrence will always follow a susceptible host, thus making the treatment approach particularly complex, involving many psychological aspects (12, 56).

The successful treatment of periodontitis is believed to prevent further progression of the tissue-destructive processes involved (13), not necessarily to obtain an ‘inflammation-free’ gingival margin. Regeneration of lost tissue may occur, but this is rare and of little magnitude, and is therefore usually not a general goal for treatment. There is, however, no agreement on how to assess treatment success. No further tooth loss, or retention of teeth during a definite time span, would be parameters that are tangible for patients (10, 26). As periodontitis develops very slowly, even without treatment (39, 40), this is difficult to assess in clinical trials. However, a few studies have been conducted with fairly long observation periods and adequate outcome variables, unfortunately without cost-effectiveness aspects included within their design (3, 20, 51). A concept named quality-adjusted tooth-years (QATYs) has been suggested (1), but this needs further development and testing before it can be recommended. Consequently, surrogate variables are used. The most common surrogate variables are strongly related to the degree of inflammation of the periodontal tissues, such as bleeding on probing, probing pocket depth and clinical attachment level. Unfortunately, the degree of inflammation is only vaguely predictive of future loss of supporting tissues and teeth (36, 57). Probably, a stable bone level, as assessed on radiographs, is the most valid assessment of no progression (27), but because of the slow development of the disease in question, even studies with bone loss as the outcome variable might require several years to provide valid information about the effect of various treatment approaches.

The systematic treatment of periodontitis thus includes thorough information about the disease, the causes and contributing factors (smoking, etc.), and the impact of personal oral hygiene in addition to the professional removal of supragingival and subgingival plaque, calculus and overhangs on restorations and crowns (retention factors) (debridement). In order to obtain access to subgingival root surfaces, surgery may be necessary (33, 66). This may comprise gingivectomy (removal of the gingiva covering the root surfaces) or flap procedures where the flaps are replaced and sutured after scaling and root planing. Treatment with antibiotics, either locally or systemically, is recommended in some cases (30, 43, 45, 48, 61, 64). In addition, other antimicrobial agents have been suggested (15, 18, 24, 31).

For mechanical debridement of the root surfaces a number of techniques and instruments have been developed, as well as suggestions on whether to treat the entire oral cavity in one setting (to avoid contamination from untreated sites) (52), or to divide the mouth into either sextants or quadrants that are treated sequentially with weeks interval between each session. Also, the sequence of treatments have been subject to discussions about, for instance, whether it is necessary to obtain a certain level of oral hygiene before treatment planning, or whether prescaling before surgery should be recommended (6).

However, few studies including the economic aspects of the various approaches have been conducted, and in those that have been carried out, the validity is often limited to one country and its social and economic situation, the people’s needs and requirements, and the national system for delivering and paying for health services; therefore, these studies have limited general validity. Some studies have estimated the time needed for performing various periodontal treatment procedures as an expression of resources needed. In the present review we will regard both time consumption and monetary costs as expression of resources required to perform treatment modalities.

Johansen et al. (28) presented the Periodontal Treatment Need System (PTNS) which is based on the three basic procedures: motivation and instruction in effective oral hygiene measures; subgingival debridement of the root surfaces of periodontally involved teeth; and debridement facilitated by surgery. The resources needed for each of these therapeutic measures were calculated as time consumption (7), and hypothetically applied to several populations (8, 29). In a later study, Mubarak & Gjermo (46) showed that the results were also applicable to patients actually treated and with acceptable accuracy. However, the Periodontal Treatment Need System does not consider maintenance, which is regarded as an important and integral part of periodontal treatment and crucial for long-term success (37, 38).
Methods

In order to approach the problem of cost-effectiveness of treatment modalities, we decided to use, as outcome variable, either tooth loss or retention, or as surrogate variables, bone level measured on radiographs (27) in randomized clinical trials. Variables indicating mostly variations in the degree of inflammation (bleeding on probing, probing pocket depth, clinical attachment level) were not accepted. Thus, we applied level 5, according to Lundgren et al. (42), as our end point, which is a rather coarse measure but which is tangible to people. In order to assess, with a certain degree of confidence, that the treatment had resulted in arrest of the progression of the disease, we required an observation time of at least 1 year.

The terms ‘cost-effectiveness’, ‘cost–benefit’ and ‘cost–utility’ have recently been discussed by Brägger (10) and we chose to use his definitions. This implies that cost-effectiveness studies could include studies where more than one treatment modality reached the same end-point and the costs were compared, or where different results were obtained at the same cost using different treatment modalities. Possible benefits (firm teeth, chewing capacity, avoiding prosthetic replacements) and adverse effects of a treatment type (sensitivity, antibiotic resistance, negative cosmetics) were disregarded.

A literature search was performed using the terms ‘periodontal therapy’ and ‘cost-effectiveness’, ‘cost’, ‘time consumption’, ‘time factor’ and ‘time’, and ‘periodontal treatment modalities’ and ‘cost-effectiveness’, ‘cost’, ‘time consumption’, ‘time factor’ and ‘time’, in Medline (PubMed) and the Cochrane Library. In addition, a hand search was performed in relevant journals after 2003 with special attention given to reference lists in review articles on related subjects.

Results

No randomized clinical trials were found that satisfied the requirements for an outcome variable that was tangible for patients (tooth loss, tooth retention, radiographic assessments of bone level) and of sufficient duration to disclose further progression of the disease after treatment (1 year). Thus, a systematic review was not possible. However, some studies that tried to address the cost-effectiveness aspects of periodontal treatment modalities were identified and our further comments are based on a narrative review of those studies and on previous reviews of related subjects.

Results and discussion of the narrative review (four treatment modalities are considered)

Information about the disease and practical training of patients in practicing home-based optimal oral hygiene

At a population level, regular check-ups, which include professional plaque removal, demonstrate positive effects upon periodontal health parameters (47), but whether this is a cost-effective strategy to apply to entire populations is questionable because efforts would be spent on individuals not at risk of periodontitis. Very few studies have been published on providing information to, and training of, adult periodontal patients, particularly where cost assessments have been taken into consideration.

Bellini (6) performed time studies on the motivation and instruction required to reach a defined level of plaque control in adult patients. He concluded that he needed an average of 72 min to reach an acceptable level of oral hygiene, and that this was not associated with baseline oral hygiene or number of teeth. Because of to the use of advertisements in the mass media and the increased awareness of the need for plaque control in the general public in western countries (22), one would predict that lower resources are now required. There are indications from studies in adolescents that the application of extra resources in the form of repeated group teaching and/or with parent participation programs, in addition to individual training in oral hygiene performance, displayed marginal gains only, compared with more simplified programs (11, 25, 44). This is in accordance with recent studies employing motivational interviewing to obtain patient compliance (12, 56).

Some improvement in plaque control, as a result of the use of electrical counter-rotational toothbrushes, has been shown in controlled trials (32, 53, 54). In this context one should mention that the cost of an electric toothbrush has not been evaluated in relation to the marginal gains reported over manual brushes in reducing plaque levels. Moreover, there are indications in the literature that ‘quit smoking’ programs may be cost-effective (16).
Subgingival debridement

Subgingival debridement is the cornerstone of all periodontal treatment (33), and many studies confirm its effectiveness in controlling mild to moderate periodontitis (pockets ≤ 5 mm) (41, 62), (2–4, 20, 35, 51). For this purpose, various techniques and instruments, both manual and machine driven, have been developed and their effect compared (14, 19, 60, 65). The majority of studies show only marginal differences in outcome and time consumption for performing the various procedures (59, 67). One recent review indicates that ultrasonic instrumentation of single-rooted teeth may yield a time gain as compared with manual debridement (65). However, because the equipment necessary for ultrasonic, laser or other machine-driven instruments infers extra costs, scaling and root planing with manual scalers may be regarded as the most cost-effective treatment modality for mild and moderate disease. In severe cases of periodontitis, adjunctive antibacterial treatment (systemically or locally applied) seems to provide a small additional benefit (23, 45, 48, 64). However, while the adjunctive use of systemically applied antibiotics may be relatively cheap, the costs for single tooth treatment with local drug-delivery systems are not negligible (10). Full-mouth debridement (52), used in combination with systemic antibiotics, has shown a small, but clinically insignificant, advantage over the conventional approach (37, 38).

For severe periodontitis (periodontal pockets ≥ 6 mm), closed nonsurgical treatment may be insufficient to arrest the disease, although this is generally recommended as the first treatment approach. The result of the nonsurgical approach must then be evaluated and surgery performed if satisfactory results are not obtained (33). From a cost-effectiveness perspective this approach will add to the costs when surgery is necessary, compared to the costs if surgery had been performed immediately (6, 7).

Access surgery

In the treatment of chronic periodontitis, periodontal surgery is performed to obtain access to affected root surfaces for the removal of calculus and biofilm (68). This may be obtained by gingivectomy or various flap procedures. The type of procedure chosen does not influence the outcome when this is assessed as no further progression of the disease, provided that optimal plaque control is maintained by the patient (55). However, lack of plaque control after periodontal surgery always results in failure (49), regardless of the surgical technique employed. This would tend to favor gingivectomy as a result of the simplicity of the method that probably renders it the more cost-effective option. However, other aspects, such as unwanted side effects (sensitivity, cosmetics), may be influenced by the technique used and should be evaluated when the choice is made. There are indications that prescaling before surgery may require more time than debridement after surgery (7). This would make it cost-effective to perform surgery without prescaling if it is obvious that surgery will be needed. It has been suggested that performing scaling during or after surgery requires less time than a systematic subgingival debridement (6, 7). The difficulty is that there are no absolute criteria to determine when surgery would be indicated.

Adjunctive systemic antibiotics have been shown to offer some advantage to the treatment outcome in severe periodontitis cases and in refractory periodontitis (45, 64), but a recent report questions the usefulness in combination with surgical approaches (23). However, the increased cost of a single course of antibiotics does not influence the total cost of treatment in a way that would be decisive for the cost-effectiveness of the treatment.

Maintenance and prevention of recurrence

There is widespread agreement in the literature that patients treated for periodontitis require life-long maintenance, with needs-related supportive care, which includes reinforcement of oral hygiene practices, scaling and prophylaxis (20, 37, 38). It is disputed how often these maintenance sessions are required, but there are indications that several times per year is no better than once a year and the value of routine professional removal of plaque has been questioned when patients’ home care is adequate (5). Also, there are indications that the outcome of supportive periodontal care is better when taken care of by specialists, compared with general practitioners, but at a higher cost (21). Noncompliance with a maintenance program, however, predictably results in the recurrence of the disease (49). Local application of antibiotics in affected pockets during maintenance care has been suggested (61), but at a higher cost (10) and with an increased risk of developing antibiotic resistance. It seems conceivable that cost-effectiveness gains may be obtained in maintenance programs, but thus far data are scarce and inconclusive.
Concluding remarks

As inflammation is variably associated with destructive disease and difficult for patients to assess, future studies on the cost-effectiveness of periodontal treatment modalities would benefit from focusing on end point variables, such as tooth loss or tooth retention, that are tangible for our patients. Because of the slow progression of chronic periodontitis, even in populations that do not receive treatment (39, 40), the study period should preferably extend to several years. The study period may be reduced if bone loss, assessed on radiographs, is employed as a surrogate outcome variable (27). Cost-effectiveness studies in many other fields in medicine have the advantage of having well-defined and distinct end points. For example, with respect to the treatment of cancer, the chosen end point is usually the 5-year survival rate. It is easier to compare the costs of different types of treatment when the expected outcome is well defined and agreed upon, compared to when it is not. Therefore, one challenge for periodontics is to develop outcome criteria that can be generally accepted and to which costs can be related.

The narrative review of articles that were not accepted for our systematic review indicates that the main cost gains in periodontal therapy would be achieved by avoiding unnecessary surgery and by applying intervals of 1 year or more in the life-long maintenance phase. Variation in other modalities would probably display only minor differences in cost.

References


