

REVIEW ARTICLE



Behavioural interventions that have the potential to improve self-care in adults with periodontitis: a systematic review

Mirkka Järvinen^a, Minna Stolt^b, Eino Honkala^c, Helena Leino-Kilpi^b and Marja Pöllänen^a

^aInstitute of Dentistry, University of Turku, Turku, Finland; ^bDepartment of Nursing Science, University of Turku, Turku, Finland; ^cDepartment of Clinical Dentistry, University of Tromsø, Tromsø, Norway

ABSTRACT

Aim: To evaluate behavioural and educational interventions used to improve self-care in adult periodontitis patients in comparison with conventional instruction.

Methods: A systematic electronic search of empirical studies that were published up to June 2017 using the MEDLINE database was performed. The reference lists of all of the included studies and articles from six separate journals were manually searched.

Results: A total of 1806 articles were identified. Six articles fulfilled the inclusion and exclusion criteria. The interventions used in periodontal treatment had theoretical backgrounds of cognitive behavioural approach, self-regulation theory of Leventhal, motivational interviewing and a client self-care commitment model. The control group in each study was described receiving conventional information. The outcomes of the interventions were classified into three categories: 1) clinical findings 2) self-reported self-care and 3) patient evaluations of the intervention. The behavioural intervention groups seemed to perform slightly better than the control groups when clinical outcome measures such as the presence of plaque or number of periodontal pockets were used. Furthermore, behavioural interventions increased patient reported compliance (e.g. effectiveness of self-care and frequency of interdental cleaning). The different behavioural techniques all seemed to work more effectively than conventional instruction. No behavioural technique could be identified superior to the other.

Conclusions: The behavioural interventions seem to be beneficial for patient adherence and may therefore improve periodontal treatment success. However, there is a need to further explore the use of different methods in studies with larger sample sizes, longer follow-up times and both behavioural and clinical outcome measures.

ARTICLE HISTORY

Received 20 December 2017

Revised 5 June 2018

Accepted 14 June 2018

KEYWORDS

Periodontitis; self-care; intervention; patient education; oral hygiene

Introduction

Periodontal health is an important aspect of health, as severe periodontitis can lead to the loss of otherwise healthy teeth [1,2] and may also have consequences for health on a general level [3,4]. Periodontitis is a chronic inflammatory disease and essential elements of the treatment are professional scaling and polishing and patients own oral self-care. A lifelong regimen of good oral self-care and professional maintenance care is required to control periodontal bone loss and to maintain the affected teeth. The effectiveness of patient self-care for the prevention of periodontitis and for maintaining a satisfactory oral hygiene status has been demonstrated in many studies and reviews [5–9]. Still, periodontitis is a common disease among people in industrialized societies [1,10,11], and the worldwide burden of periodontitis shows no decrease over a 20 years perspective from 1990 to 2010 [12]. Striking is that both the incidence and prevalence of severe periodontitis (clinical attachment loss >5 mm) increases rapidly already in the 20–30 years olds [12]. Therefore, effective methods supporting periodontal treatment and improving oral self-care should be evaluated and implemented.

Tooth brushing twice a day, with interdental cleaning, has been shown to effectively reduce plaque and gingival inflammation [13,14]. Regular interdental cleaning has also been shown to improve periodontal health [8,15]. However, several studies have reported non-compliance with oral health-care recommendations [11,16,17], and traditional educational interventions have been shown to be of little value in achieving long-term behavioural changes [18]. Thus, there is a great need for effective interventions that can improve patient adherence to oral hygiene instruction [19], particularly to improve long-term treatment success in periodontal patients [20].

The aim of this systematic review was to evaluate behavioural and educational interventions used to improve self-care in adult periodontal patients in comparison with conventional instruction.

Materials and methods

The outcomes of behavioural or educational interventions that improve self-care in adult periodontitis patients were evaluated in terms of 1) clinical findings, 2) self-reported

self-care and 3) patient evaluations of the intervention, and in comparison, with conventional instruction. Furthermore, we described the quality of the intervention studies and the theoretical backgrounds of these interventions

Search strategy

A detailed search strategy was devised to collect the studies for this review (Table 1). The international database MEDLINE was used to find the relevant literature [21,22] that were published up to June 2017. The search involved using both MeSH and free text terms. The following search terms and combinations of terms were used: oral health, gingivitis, periodontitis, periodontal disease, oral hygiene, mouth, dental, care, plaque, tooth, teeth, tongue, health education, health promotion, patient education, teaching, training, advising, instructing, guiding, demonstration, supervise and self-care. The search was limited to reports in the English language that were conducted on adults, including comparative clinical studies, controlled clinical trials and randomized controlled trials. Additionally, a manual search was conducted in the following journals: Journal of Clinical Periodontology, Periodontology 2000, Community Dentistry and Oral Epidemiology, International Journal of Dental Hygiene, Community Dental Health and Patient Education and

counselling. The reference lists corresponding to all of the included studies were examined.

The inclusion criteria were as follows: studies of behavioural or educational interventions aimed at supporting self-care in adults with periodontitis on participants aged 18 years or over. Self-care was defined as both brushing and inter dental cleaning. The exclusion criteria were the following: interventions focussing on the use of pharmaceuticals or those comparing oral hygiene products, participants' pocket depths were <4 mm, or participants that only had gingivitis. We also excluded studies with periodontally healthy adults because we wanted to focus on and later to develop a strategy for high-risk groups.

The data collection process was conducted systematically in four separate phases. In the first phase, 1806 titles that were found in MEDLINE were examined against the inclusion criteria. Two researchers (MJ + MS) worked independently to accomplish the first phase of the review; after selection, they discussed the choice of abstracts for further analysis. Based on the abstracts, a total of 33 studies met the inclusion/exclusion criteria. In the second phase, the same two researchers re-examined the abstracts and selected 18 studies for further analysis. In the third phase, the full texts of the articles were reviewed against the inclusion/exclusion criteria; 6 studies were selected and included in this review. In the fourth phase, no additional articles for inclusion were found in the manual searches of the reference list from the included articles and from the above-mentioned journals.

Table 1. A systematic literature search.

```
#1 ORAL HEALTH
#2 (gingiva$ next inflamm$) or (gingiva$ next bleed$) or (gingiva$ next
pocket$) or (periodont$ next pocket$) or (periodont near attachment) or
(gingiva$ near attachment)
#3 (oral next health) or (dental next health)
#4 #1 OR #2 OR #3
#5 Exp ORAL HYGIENE
#6 (oral next hygiene) or (mouth near care) or (dental near care) or (care near
teeth) or (mouth next hygiene) or (plaque near control$) or (plaque
near remov$)
#7 ((interdental next clean$) or (inter-dental next clean$) or (tooth next
clean$) or (teeth near clean$) or (tongue next scrap$) or (tongue
next brush$))
#8 ((dental or tooth or teeth or interdental$ or inter-dental$) and floss$))
#9 ((dental next plaque next index) or (periodontal next index) or (gingival
next index))
#10 #5 OR #6 OR #7 OR #8 OR #9
#11 Exp HEALTH EDUCATION DENTAL
#12 Exp HEALTH EDUCATION ORAL
#13 Exp HEALTH PROMOTION
#14 Exp PATIENT EDUCATION
#15 educat$ or teach$ or train$ or advice$ or advise$ or instruct$ or guide$
#16 ((health$ near promot$)) and (dental or teeth or mouth or periodont$ or
gingival$ or (oral next health))
#17 ((demonstrat$ near toothbrush$) or (demonstrat$ near "tooth brush$) or
(demonstrat$ near tooth-brush$) or (demonstrat$ near floss$) or (demon-
strat$ near "oral hygiene$") or (demonstrat$ near interdental clean$) or
(demonstrat$ near inter-dental clean$) or (demonstrat near "tooth pick") or
(demonstrat$ near tooth pick))
#18 ((supervis$ near toothbrush$) or (supervis$ near floss$) or (supervis$ near
tooth pick$) or (supervis$ near "interdental cleaning") or (supevis$ near
"oral hygiene"))
#19 OR #11 OR #12 OR #13 OR #14 # OR 15 OR #16 OR #17 OR #18
#20 SELF CARE
#21 #19 OR #20
#22 (#4 OR #10) AND (#19 OR #21)
#23 Limit #22 to (english language and "all adult")
#24 Limit #23 to (clinical trial all, comparative study or controlled clinical trial
or randomized controlled trial)
```

Outcome measures

The outcomes of the behavioural (or educational) interventions were measured in comparison with conventional instruction and categorized to 1) clinical findings, 2) self-reported self-care and 3) patient evaluations of the intervention. Clinical findings were measured using the following indicators: Plaque Index (PII) [23], plaque percent [24], Gingival Index (GI) [25], Bleeding on Probing (BoP) [26] and Probing Pocket Depth (PD) (Table 2). Patient adherence to the treatment (compliance, self-reported self-care frequency) and patient evaluation of the intervention were described if reported in the study.

Methodological and scientific aspects of the included studies

The theoretical background of the behavioural interventions in each included study was described. To assess the quality of the included studies, the items included in the CONSORT checklist were used. The CONSORT checklist has been developed to improve the quality of reporting RTCs and it contains 22 items [27]. A score of "1" was given to each list item that was reported in the publication, and the scores of each trial were summed to give overall scores (Table 3).

Table 2. Clinical measurements used in patients.

Study	Plaque Index (PII) [23]	Gingival Index (GI) [25]	Plaque percent [24]	Probing pocket Depth (PD)	Bleeding on Probing (BoP) [26]
Godard et al. [30], France			X		
Jönsson et al. [31], Sweden	X	X			
Jönsson et al. [33], Sweden	X	X		X	X
Philppot et al. [32], Belgium	X				
Baab & Weinstein [28], USA			X		X
Glavind & Zeuner [29], Denmark			X		X

Table 3. Quality assessment of the studies using the CONSORT checklist.

Quality parameter	References					
	Godard et al. [30]	Jönsson et al. [31]	Jönsson et al. [33]	Philppot et al. [32]	Baab & Weinstein [28]	Glavind & Zeuner [29]
Randomized allocation	1	1	1	1	1	0
Scientific background	1	1	1	1	0.5	1
Eligibility, setting and location	1	1	1	1	1	1
Intervention	1	1	1	1	1	1
Objectives and hypotheses	0	1	0.5	0.5	0.5	0.5
Outcome measures	1	1	1	1	1	1
Sample size	0	1	0	0	0	0
Sequence generation	1	1	1	0	1	0
Allocation concealment	0	1	1	0	1	0
Randomization implementation	0	1	0	0	0	0
Blinding	1	1	1	0	0	1
Statistical methods	1	1	1	1	1	1
Participant flow	1	1	1	0	0	0
Recruitment	1	1	1	0.5	1	1
Baseline data	1	1	1	1	0.5	1
Numbers analyzed	1	1	1	1	0	1
Outcomes and estimation	0	1	1	0	0	0
Ancillary analyses	0	0	0	0	0	0
Adverse events	0	0	0	0	0	0
Interpretation	0.5	0.5	0.5	1	1	0.5
Generalizability	0	1	0	0	0	0
Overall evidence	1	1	1	1	1	1
Total score	13.5/22	19.5/22	16/22	11/22	11.5/22	11/22

Results

Methodological and scientific aspects of the included studies

A total of six studies [28–33] describing six different behavioural or educational interventions aimed to improve oral self-care in adults with periodontitis were selected for this review (Table 4), as described in the methods section. The sample sizes varied between 24 and 113 individuals and follow-up times from four weeks to 12 months. The studies were conducted on adults ranging from 20 to 80 years of age (mean 47.6) who had moderate to severe periodontitis.

A quality assessment of the six included studies that examined the effects of patient educational interventions on the self-care of adults with existing periodontitis was performed according to the items included in the CONSORT checklist (Table 3). Many of the included studies had numerous methodological problems that affected the strength of their results and their further generalizability. First, sample sizes were small (mean $n = 36$), and only one of the studies reported the use of power analysis. The absence of a power calculation is problematic, as the reader cannot determine

whether non-significant results are a consequence of inadequate sample size. Second, the follow-up times in these studies varied considerably, but generally they were rather short, ranging from four weeks to six months; one study included a one-year-long follow-up period. All studies reported using a randomized controlled trial design, comparing one experimental group to a control group. However, the randomization process was described in four of these six studies [28,30,31,33] and two of them failed to supply all of the key information regarding randomization that is required by the CONSORT checklist. None of the studies commented on the generalizability of their results.

Traditional instruction without the use of any specific behavioural methods was employed in 2 of the studies [28,29]. These studies explored the additional use of patient self-inspection [28] or audiovisual instruction [29] on oral hygiene. The remaining 4 studies [30–33] compared various behavioural approaches to traditional patient instruction. The theoretical frameworks used in these studies included cognitive behavioural approaches [31,32], the self-regulation theory of Leventhal [30], motivational interviewing [30,33] and the client self-care commitment model [33]. All these

Table 4. Studies of educational interventions.

Authors, country, year	Participants, sample size, group size	Methods	Intervention	Baseline measures	Final measures	Outcomes
Godard et al. [30], France	mean age 49.5 years, $n = 51$ I group $n = 24$ C group $n = 27$	RCT, evaluator blinded. Randomization was performed with sealed, mixed envelopes. Follow-up time: 4 weeks	Motivational interview guided by Leventhal's theory (I group) vs. oral hygiene instructions as usually practiced in service (C group)	I group Plaque mean % ($\pm$ SD) Lingual 35 (± 0.23) Buccal 58 (± 0.28) Proximal 65 (± 0.22) C group Plaque mean % ($\pm$ SD) Lingual 37 (± 0.23) Buccal 59 (± 0.19) Proximal 68 (± 0.23)	I group Plaque mean % ($\pm$ SD) Lingual 18 (± 0.20) Buccal 29 (± 0.29) Proximal 45 (± 0.30) C group Plaque mean % ($\pm$ SD) Lingual 27 (± 0.16) Buccal 43 (± 0.22) Proximal 73 (± 0.27)	Baseline through 4 weeks follow-up All PI values improved ($p < .001$) except in the proximal surfaces of the control group ($p = .12$). The experimental group showed an improvement of $21 \pm 20\%$ versus $4 \pm 5\%$ for the control ($p < .001$)
Jönsson et al. [31], Sweden	mean age 51 years, $n = 113$ I group $n = 57$ C group $n = 56$	RCT, evaluator blinded. Randomization was made in blocks of various sizes by a random computer table. Follow-up time: 3 and 12 months	Individually tailored oral health educational program based on a cognitive behavioural approach (I group 5-9 visits) vs. traditional education (C group 4-8 visits). One visit 45 to 60 minutes.	I group mean (SD) GI Global 0.92 (0.28) GI Proximal 1.14 (0.27) PII Global 0.74 (0.34) PII Proximal 1.01 (0.37) C group mean (SD) GI Global 0.92 (0.23) GI Proximal 1.13 (0.23) PII Global 0.73 (0.31) PII Proximal 0.99 (0.35)	3 month follow-up I group mean (SD) GI Global 0.27 (0.14) GI Proximal 0.37 (0.17) PII Global 0.17 (0.11) PII Proximal 0.29 (0.22) C group mean (SD) GI Global 0.52 (0.20) GI Proximal 0.72 (0.17) PII Global 0.32 (0.22) PII Proximal 0.48 (0.28) 12 month follow-up I group mean (SD) GI Global 0.21 (0.16) GI Proximal 0.28 (0.20) PII Global 0.14 (0.13) PII Proximal 0.23 (0.19) C group mean (SD) GI Global 0.50 (0.17) GI Proximal 0.69 (0.20) PII Global 0.31 (0.16) PII Proximal 0.49 (0.22)	Baseline through 3-month mean gain score difference (CI 99.2%) between groups GI Global 0.27 (0.14–0.41) $p < .001$ GI Proximal 0.36 (0.22–0.50) $p < .001$ PII Global 0.17 (0.02–0.32) $p = .003$ PII Proximal 0.22 (0.04–0.40) $p = .001$ 3–12 month mean gain score difference (CI 99.2%) GI Global 0.03 (–0.03 to 0.09) ns GI Proximal 0.03 (–0.13 to 0.06) ns PII Global 0.02 (–0.04 to 0.09) ns PII Proximal 0.08 (0.00–0.16) $p = .013$ Baseline through 12 month mean gain score difference (CI 99.2%) between groups GI Global 0.27 (0.16–0.39) $p < .001$ GI Proximal 0.40 (0.27–0.53) $p < .001$ PII Global 0.16 (0.03–0.30) $p < .001$ PII Proximal 0.26 (0.10–0.43) $p < .001$ A higher proportion of individuals in the intervention group estimated that they were able to effectively perform oral self-care than in control group. Participants in the intervention group also reported daily compliance with the taught skills and estimated a higher likelihood of maintaining new habits than participants in the control group.

(continued)

Table 4. Continued.

Authors, country, year	Participants, sample size, group size	Methods	Intervention	Baseline measures	Final measures	Outcomes
Jönsson et al. [33], Sweden	20–80 years, $n = 35$ I group $n = 19$ C group $n = 16$	RCT, single blind. Randomization performed by lottery. Follow-up time: 12–14 weeks	Self-care education using CSCCM (I group, 4 visits) vs. traditional education (C group, 3 visits)	I group Brushing: once a day $n = 3$, twice a day $n = 16$ Interdental cleaning ≥ 5 times/week: 4 PII: 0.59 ± 0.17 GI: 0.73 ± 0.14 BoP (%): 46.8 ± 13.8 PD (number of pockets > 4 mm): 5.8	I group Brushing: once a day $n = 3$, twice a day $n = 16$ Interdental cleaning ≥ 5 times/week: 19 PII: 0.25 ± 0.11 GI: 0.38 ± 0.20 BoP (%): 18.7 ± 8.3 PD (number of pockets > 4 mm): 2.7	No change in frequency of tooth brushing. Statistically significant difference between groups in interdental cleaning (I group 79 %–C 6 %, $p = .008$) Statistically significant difference between groups in plaque reduction (I group 56 %–C 35 %, $p = .02$)
Philippot et al. [32], Belgium	20–68 years, $n = 30$ I group $n = 15$ C group $n = 15$	RCT Randomization not described. Follow-up time: 4 weeks	Information and training of self-care and behavioural education (I group) vs. information and training of self-care (C group)	C group Brushing: $n = 16$ twice a day Interdental cleaning ≥ 5 times/week: 10 PII: 0.59 ± 0.29 GI: 0.65 ± 0.23 BoP (%): 39.0 ± 16.0 PD (number of pockets > 4 mm): 4.9	C group Brushing: $n = 16$ twice a day Interdental cleaning ≥ 5 times/week: 11 PII: 0.33 ± 0.11 GI: 0.39 ± 0.14 BoP (%): 16.3 ± 5.7 PD (number of pockets > 4 mm): 2.9	Statistically significant reduction of GI and BoP in both groups (I group: $p < .0001$, BoP $p < .0001$, C group: $p = .001$, BoP $p = .0001$) Significant reduction in the number of pockets in the I group. No statistically significant difference between the groups in baseline or final examination.
Baob & Weinstein [28], USA	30–76 years, $n = 31$ I group $n = 15$ C group $n = 16$	RCT. Randomization performed by rolling of dice. Follow-up time: 2 weeks, 1½, 3 and 6 months.	Both groups: oral hygiene skills assessment, instructions, scaling. I group: oral self-inspection manual and instructions, equipment for self-inspection.	I group PII Global 1.63 PII Lingual 1.87 PII Buccal 1.13 Proximal 1.83 C group PII Global 1.88 PII Lingual 2.03 PII Buccal 1.41 Proximal 2.19	I group PII Global 0.24 PII Lingual 0.22 PII Buccal 0.08 Proximal 0.43 C group PII Global 0.88 PII Lingual 0.84 PII Buccal 0.45 Proximal 1.34	At baseline, all patients had a mean PII above 0.5. At follow-up, 13/15 patients in the intervention group and 3/15 in the control group had a mean PII below 0.5. Plaque percent. Significant difference in I group from baseline Significant difference in I group in time. Bleeding: no significant reduction from baseline in either group.

(continued)

Table 4. Continued.

Authors, country, year	Participants, sample size, group size	Methods	Intervention	Baseline measures	Final measures	Outcomes
Glavind & Zeuner [29], Denmark	32–63 years, <i>n</i> = 24 I group <i>n</i> = 12 C group <i>n</i> = 12	Pre-test, post-test. No randomization. Follow-up time: 2, 3 and 8 weeks.	Both groups: scaling and oral hygiene instructions. Intervention group: reinforcement of the oral hygiene instructions by videotape at the 3-week follow-up.	I group Plaque % (SD) start 62 (16.8) Gingival bleeding % (SD) start 51 (19.8) C group Plaque % (SD) start 58 (16.2) Gingival bleeding % (SD) start 45 (14.8)	I group Plaque % (SD) 2 weeks 59 (16.7) 3 weeks 29 (19.5) 8 weeks 28 (16.3) Gingival bleeding % (SD) 8 weeks 29 (17.0) C group Plaque % (SD) 2 weeks 52 (18.4) 3 weeks 23 (19.0) 8 weeks 22 (12.5) Gingival bleeding % (SD) 8 weeks 24	No statistically significant difference between the groups.

behavioural approaches aim at not only maintaining the oral health of the patient but also at understanding and managing the disease; they differ in their approaches to achieving these aims. The theoretical background and essential components of different theories are presented in Table 5.

In addition to the use of educational or behavioural methods, professional scaling and root planing was performed in all studies [28–33]. Educational and behavioural intervention was complemented with oral instructions [28,30,31,33], written information [28,29], demonstration of plaque [29,31,33], demonstration of oral self-care [31], goal-setting [31,33], videotape [29] or a diary [32]. The interventions in these studies consisted of one to five visits, and their durations were described in three studies, which included 15–20 minute [30], 30 minute [28] and 45–60 minute [31] interventions.

Outcomes of behavioural and educational interventions

The outcomes of the interventions were classified into three categories: 1) clinical findings (i.e., oral hygiene), 2) self-reported self-care (i.e., compliance) and 3) patient evaluations of the intervention. Because of the variety in clinical measures as well as in reporting patient compliance and adherence, the effects could not be quantitatively compared in this review.

Regarding clinical findings, the only outcome that was measured in all studies was the amount of plaque (Table 2). PII was used as an outcome measure in three of the six studies, and the percentage of plaque was used in three of the studies. Plaque amounts decreased following all of the interventions in all of the groups, and statistically significantly stronger decrease in the intervention group than in the control group was found in four studies that used behavioural intervention [30–33] (Table 4).

Gingival bleeding (GI, BoP or gingival bleeding %) was measured in four of these studies: it exhibited statistically significantly stronger decrease in the intervention group compared to control group in one study using behavioural intervention [31]. In two other studies [29,33], gingival bleeding was decreased in both the intervention and control groups and there was no difference between the groups. One study [28] using reinforced instruction and self-inspection found no significant reduction in gingival bleeding in either group. PD, which indicates the state of periodontal attachment, was used in one study [33]. A statistically significant reduction in the number of pockets was found both in the intervention and control groups, but no difference between the groups (Table 4).

Self-reported outcomes of self-care included frequency of tooth brushing and interdental cleaning. One study reported brushing frequency and found no differences in it. However, almost all participants brushed twice a day already at baseline [33]. Interdental cleaning was found to statistically significantly increase in the behavioural intervention group [33]. In Jönsson's study [31], participants evaluated their self-care. A higher proportion of individuals in the intervention group estimated that they were able to perform oral self-care

Table 5. The theoretical background and essential components of different theories used in the included studies.

Behavioural intervention technique	Theoretical background	Elements used in the intervention
Cognitive behavioural approach Jönsson et al. [31] Philippot et al. [32]	Understanding how different factors influence health behaviour • characteristics of a person • behaviour of the person • environment within which the behaviour is performed	Information about the symptoms of periodontitis and its causes, consequences and temporal course Effective strategies offered for managing the disease; daily record of self-care the effects of self-care on periodontitis symptoms.
Self-regulation theory of Leventhal Godard et al. [30]	Health behaviour is determined by the persons' representation of the illness Illness representations have both cognitive and emotional aspects, which are constructed through experiences and through information received from the social environment and health professionals	Questionnaire concerning periodontal symptoms and their consequences on everyday life, performed self-care and expectations of the treatment. Sessions of motivational interviewing (based on clinician empathy, discrepancy between patients' goals and values and their current behaviour, and lack of argumentation or direct confrontation), while addressing the five dimensions of Leventhal's theory
Motivational interviewing Godard et al. [30], Jönsson et al. [31],	Client-centered directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence	Educational information based on participants' thoughts, intermediate and long-term goals and oral health status. Discussions regarding knowledge, expectations and motivation • an analysis of oral self-care • manual dexterity practice for the use of oral hygiene aids • goal setting and self-monitoring • strategies for maintaining already achieved goals
Client self-care commitment model Jönsson et al. [33],	Five domains: initiation, assessment, negotiation, commitment, and evaluation Interactions between a client and a professional can empower clients to make decisions that will enhance their own health through commitment and compliance	Discussion about • patients' self-care methods • their own views about the disease process • their experiences of their treatments • their beliefs concerning the reasons for disease progress Demonstration and discussion of the latest periodontal status Information on oral hygiene provided as necessary.

effectively compared to the control group. Participants in the intervention group also reported daily compliance with the skills they were taught, and they estimated a higher likelihood of maintaining their new habits than the participants in the control group.

Patient evaluations of the interventions were included in three of the studies [29,30,33]. In a study by Glavind et al. [29], ten out of twelve patients indicated that it was advantageous to watch a videotape demonstration of self-care. A demonstration of small brush movements and the use of disclosing tablets were also mentioned as being helpful [29]. In a study by Jönsson et al. [33], the intervention group patients were asked to evaluate whether providing a written commitment had influenced their oral self-care habits. The majority of the individuals in this group reported that the commitment had positively influenced their self-care habits. In a study by Godard et al. [30], three questions were asked about communication. Patients in the experimental group reported greater satisfaction scores than patients in the control group. The experimental group patients felt that after talking with their dentist they understood the health of their teeth and therefore gained understanding of the possible changes that could occur in their oral health status. They also felt that the dentist told them everything that they wanted to know.

Participant knowledge of periodontitis prior to educational intervention was assessed in one study via a self-report questionnaire [32]. The questions covered symptoms, causes and possible consequences of periodontitis, as well as control strategies for periodontitis. Participants clearly recognized many of the relevant symptoms of periodontitis, but their knowledge about the causes of the disease was very poor. With respect to the consequences of periodontitis, higher acceptance ratings were reported in patients with correct responses than in those with incorrect ones. However, the participants demonstrated only limited knowledge regarding the most effective methods of addressing periodontitis [32].

Discussion

Although periodontitis presents a major challenge for oral health care professionals, we found only few behavioural intervention studies that have focussed on adults with periodontitis. The majority of the evidence that was produced in the included studies was not robust, which was primarily due to small sample sizes, lack or unclearly reported randomization process and very short follow-up times. Only one included study [31] had a follow-up-period for 12 months and another study [28] for 6 months. For a long time success

of periodontal management patients should be followed for several years as done in the study of Preus et al. [14]. However in their study, only patients with high standard of oral hygiene (<15% of sites with plaque) after pre-study hygiene phase were included. Our review instead, included patients with inadequate oral hygiene and studied the initial behavioural change. Therefore, also short time studies [29,30,32,33] were included. Such studies with short time follow-up (4–14 weeks) have the potential to show behavioural change that can benefit the initial anti-infective treatment phase. If no improvement in self-care happens in the beginning, most probably it will not happen later on without additional motivation. However, long time or established changes to oral self-care routines cannot be observed with such short follow-up times. It has been estimated that the maintenance of a new health behaviour may last from six months to about five years [34] and often needs re-motivation and instruction as was done in the study of Preus et al. [14].

To assess the quality of the included studies, we used the items of the CONSORT checklist. Other methods such as the risk of bias assessment by the Cochrane handbook [35] could have been used. Related items are included in both assessment tools and most probably the main concerns raised by our study would have been the same using either assessment tool.

This review concentrated on the main outcomes of behavioural interventions at three aspects of self-care in adults with periodontitis i.e. clinical findings, patient compliance and patient evaluations of the interventions. Variable definitions for periodontitis were used in the included studies, some studies reported including patients with moderate or severe periodontitis [30,31], some reported including periodontitis patients [28,32,33] and some patients with minor periodontitis changes [29]. Patients were either in the anti-infective phase of the treatment [29–32] or had inadequate oral hygiene in the maintenance phase [28,33].

Since the clinical outcome measures that were used in the studies mainly described the state of oral hygiene (plaque indexes, plaque percent, bleeding indexes) and gingival inflammation, not the state or progression of periodontitis, the variation in periodontitis definitions in the included studies doesn't seem to be a problem. Consistently, studies using behavioural methods or self-inspection showed significantly improved plaque control in the intervention group compared to control. Outcome measures such as probing pocket depth, x-rays and measurements of attachment loss would reveal the healing and recovery or progression of periodontitis. One included study reported PD measurements [33] as an outcome measure. Although this study showed a statistically significant reduction in the number of >4 mm pockets 3 months after treatment in the intervention group, this outcome should not be regarded solely as an effect of the behavioural approach. SRP was used in the beginning of the study, and patient self-care interventions were an additional but essential part of the treatment response. It is clear that periodontitis cannot be treated only by self-care. However, it can be concluded that behavioural interventions seem to

improve the outcomes of self-care in periodontitis patients. Patients' skills, knowledge, level of motivation and values should therefore be taken into account in educational interventions for periodontitis patients.

Behavioural approaches were not able to increase the frequency of tooth brushing. Conversely, almost all the examined patients brushed their teeth twice a day [33], which agrees with current recommendations. However, behavioural approaches did appear to be more effective in increasing the frequency of interdental cleaning than traditional methods. Increasing the frequency of interdental cleaning is often very important in obtaining adequate management of periodontitis. Also, participants in the intervention group [31] estimated a higher likelihood of maintaining the new habits than the participants in the control group, which is important regarding the long-term success of periodontal management. Patient evaluations revealed that behavioural interventions resulted in better understanding of the disease process than control interventions and a written commitment influenced positively their self-care habits. Another review [36] regarding behavioural interventions in periodontal disease management found goal setting, self-monitoring and planning useful in improving plaque control.

Due to high degree of heterogeneity in the included studies, both in terms of the outcome measures and behavioural or educational methods used, it was impossible to conduct meta-analysis. This review had some other limitations too. For example, only one database was searched; however, MEDLINE is also the most widely used and extensive database that is available in the health sciences [21,22]. Limiting the included studies to those, which were published in English means that the number of studies may have been underestimated. Despite these limitations, however, the review likely covered the most relevant publications on this topic. Clinical findings, patient compliance and patient evaluations of the interventions were the main outcomes of this study. These three aspects allowed a rather holistic view on the topic and can be considered a strength of this review. Additionally, the systematic nature of our search and the multiple search terms and combinations of terms that were used increase the validity of the study. To improve the reliability of our analysis, data collection was performed by two independent researchers (MJ + MS), and both agreed with the results.

Conclusions

The behavioural interventions seem to be beneficial for patient adherence and may therefore improve initial periodontal treatment success. However, there is a need to further explore the use of different methods in studies with larger sample sizes, longer follow-up times and both behavioural and clinical outcome measures.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

Language edition was funded by the Finnish Dental Society Apollonia.

References

- [1] Kelly M, Steele J, Nuttall N. Adult dental health survey: oral health in the United Kingdom 1998. London: Her Majesty's Stationery Office; 2000.
- [2] Larsen T, Fiehn N-E. Dental biofilm infections – an update. *APMIS*. 2017;125:376–384.
- [3] Tonetti MS, Van Dyke TE. Special issue: periodontitis and systemic diseases – proceedings of a workshop jointly held by the European Federation of Periodontology and American Academy of Periodontology. *J Clin Periodontol*. 2013;40(Suppl):S24–S209.
- [4] Beck J, Offenbacher S. Systemic effects of periodontitis: epidemiology of periodontal disease and cardiovascular disease. *J Periodontol*. 2005;76:2089–2100.
- [5] Axelsson P, Nyström B, Lindhe J. The long-term effect of a plaque control program on tooth mortality, caries and periodontal diseases in adults – results after 30 years of maintenance. *J Clin Periodontol*. 2004;31:749–757.
- [6] Morrison EC, Ramfjord SP, Hill RW. Short-term effects of initial nonsurgical periodontal treatment (hygienic phase). *J Clin Periodontol*. 1980;7: 199–211.
- [7] Vatne JF, Gjermo P, Sandvik L, et al. Patients' perception of own efforts versus clinically observed outcomes of non-surgical periodontal therapy in a Norwegian population: an observational study. *BMC Oral Health*. 2015;15:61–68.
- [8] Chapple ILC, Van der Weijden F, Doerfer C, et al. Primary prevention of periodontitis: managing gingivitis. *J Clin Periodontol*. 2015;42(Suppl.):S71–S76.
- [9] Needleman I, Nibali L, Di Iorio A. Professional mechanical plaque removal for prevention of periodontal diseases in adults – systematic review update. *J Clin Periodontol*. 2015;42(Suppl.): S12–S35.
- [10] Albandar JM. Periodontal diseases in North America. *Periodontol* 2000. 2002;29:31–69.
- [11] Suominen TL, Nordblad A, Vehkalahti M, et al. (Eds.). Oral health of the Finnish adults – health 2000 survey. 2004. Helsinki: Publications of the National Public Health Institute B16/2004. (In Finnish, English summary).
- [12] Kassebaum NJ, Bernabé E, Dahiya M, et al. Global burden of severe periodontitis in 1990–2010: a systematic review and meta-regression. *J Dent Res*. 2014;93:1045–1053.
- [13] Yaacob M, Worthington HV, Deacon SA, et al. Powered versus manual toothbrushing for oral health. *Cochrane Database Syst Rev*. 2014;6:1–140.
- [14] Preus HR, Gjermo P, Baelum V. A double-masked randomized clinical trial (RCT) comparing four periodontitis treatment strategies: 5-year clinical results. *J Clin Periodontol*. 2017;44:1029–1038.
- [15] Jackson MA, Kellett M, Worthington HV, et al. Comparison of interdental cleaning methods: a randomized controlled trial. *J Periodontol*. 2006;77:1421–1429.
- [16] Hugoson A, Koch G, Bergendal T, et al. Oral health of individuals aged 3–80 years in Jönköping, Sweden in 1973, 1983, and 1993. I. Review of findings on dental care habits and knowledge of oral health. *Swed Dent J*. 1995;19:225–241.
- [17] MacGregor ID, Balding JW, Regis D. Flossing behaviour in English adolescents. *J Clin Periodontol*. 1998;25:291–196.
- [18] Renz A, Ide M, Newton T, et al. Psychological interventions to improve adherence to oral hygiene instructions in adults with periodontal diseases. *Cochrane Database Syst Rev*. 2007; 2. DOI:10.1002/14651858.CD005097.pub2.
- [19] Wilson TG. Jr. Compliance and its role in periodontal therapy. *Periodontol* 2000. 1996;12:16–23.
- [20] Lee CT, Huang HY, Sun TC, et al. Impact of patient compliance on tooth loss during supportive periodontal therapy: a systematic review and meta-analysis. *J Dent Res*. 2015;94:777–786.
- [21] Brazier H, Begley CM. Selecting a database for literature searches in nursing: MEDLINE or CINAHL? *J Adv Nurs*. 1996;24:868–875.
- [22] Subirana M, Solá I, García JM, et al. A nursing qualitative systematic review required MEDLINE and CINAHL for study identification. *J Clin Epidemiol*. 2005;58:20–25.
- [23] Silness J, Loe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand*. 1964; 22:121–135.
- [24] Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. *Int Dent J*. 1975;25:229–235.
- [25] Loe H. The Gingival Index, the Plaque Index and the Retention Index Systems. *J Periodontol*. 1967;38:610–616.
- [26] Lang N, Joss A, Orsanic T, et al. Bleeding on probing. A predictor for the progression of periodontal disease? *J Clin Periodontol*. 1986;13:590–596.
- [27] Moher D, Schulz KF, Altman DG. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. *Lancet*. 2001;357:1191–1194.
- [28] Baab D, Weinstein P. Longitudinal evaluation of a self-inspection plaque index in periodontal recall patients. *J Clin Periodontol*. 1986;13:313–318.
- [29] Glavind L, Zeuner E. Evaluation of a television-tape demonstration for the reinforcement of oral hygiene instruction. *J Clin Periodontol*. 1986;13:201–204.
- [30] Godard A, Dufour T, Jeanne S. Application of self-regulation theory and motivational interview for improving oral hygiene: a randomized controlled trial. *J Clin Periodontol*. 2011;38: 1099–1105.
- [31] Jönsson B, Öhrn K, Oscarson N, et al. The effectiveness of an individually tailored oral health educational programme on oral hygiene behaviour in patients with periodontal disease: a blinded randomized-controlled clinical trial (one-year follow-up). *J Clin Periodontol*. 2009;36:1025–1034.
- [32] Philippot P, Lenoir N, D'Hoore W, et al. Improving patients' compliance with treatment of periodontitis: a controlled study of behavioural intervention. *J Clin Periodontol*. 2005;32:653–658.
- [33] Jönsson B, Lindberg P, Oscarson N, et al. Improved compliance and self-care in patients with periodontitis – a randomized control trial. *Int J Dent Hyg*. 2006;4:77–83.
- [34] US Department of Health and Human Services (USDHHS). 1990. The health benefits of smoking cessation: a report of the Surgeon General. Washington, DC: US Department of Health and Human Services US Department of Health and Human Services, DHHS Publication No (CDC) 90_8416.
- [35] Higgins JPT, Altman DG, Sterne JAC. (editors). Chapter 8: Assessing risk of bias in included studies. In: Higgins JPT, Green S, editors. *Cochrane handbook for systematic reviews of interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011. Available from www.cochrane-handbook.org.
- [36] Newton TJ, Asimakopoulou K. Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behavior change for improved plaque control in periodontal management. *J Clin Periodontol*. 2015;42: S36–S46.