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Improving patients' compliance with the treatment of periodontitis: a controlled study of behavioural intervention

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Abstract

Objectives: This clinical trial study investigates whether a behavioural educational intervention based on the autoregulation theory can improve periodontitis patients' compliance with proper dental care at a 1-month follow-up.

Material and Methods: Thirty patients matched for gender (20 men), age (mean age = 39 years) and education were randomly assigned to a control or an experimental treatment condition. In the control condition, patients received the regular treatment based on instruction of the proper prophylactic dental care. In the experimental treatment condition, patients received information about the symptoms of periodontitis, the causes, consequences and temporal course, and the types of effective strategy and they were requested to keep daily records of the effects of applying prophylactic dental care on their periodontitis symptoms. In both groups, plaque indices (PIs) (Silness & Löe 1964) were measured prior to treatment and at a 1-month follow-up. A self-report questionnaire also assessed the representation of periodontitis in all patients.

Results: A 2 (time of measurement: baseline *versus* follow-up) × 3 (PI localization) × 2 (experimental group) mixed-design ANOVA computed on the PI reports a large effect of time, $F(1, 28) = 267.10$, $p < 0.000$, indicating that both groups improved from baseline (mean = 1.73, SD = 0.08) to the 1-month follow-up (mean = 0.56, SD = 0.06). It is important to point out that this analysis also revealed the expected Group × Time interaction, $F(1, 28) = 7.09$, $p < 0.02$, partial $\eta^2 = 0.19$, indicating that smaller PI were observed in the experimental group (mean = 0.24, SD = 0.14) than in the control group (mean = 0.88, SD = 0.38) at follow-up. Post hoc analyses showed that this pattern applies to the proximal and lingual PI but not to the vestibular PI.

Conclusions: The present data show that the behavioural education intervention is (a) more effective than a classical intervention based on information and training about prophylactic techniques and (b) that it is effective in bringing most patients to normal levels of PI. For clinical practice, it suggests that better results can be obtained if (a) patients are taught a correct representation about periodontitis and (b) patients' sense of self-efficacy is developed through their own direct experience, by observing the effects of their behaviour on periodontitis symptoms.

Key words: behavioral intervention; chronic periodontitis; compliance; illness representation

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Periodontitis has major consequences for people's health, at a dental level, as well as at a much more general level (Offenbacher 1999, Genco et al. 2001). A major aspect of the effective treatment of this consequential condition is proper oral hygiene (Morris et al. 2001) which consists in a combination of toothbrushing, inter-dental cleaning,

and, when necessary, chemotherapeutic agents (e.g. mouthwash) (Ciancio 2003).

Such oral hygiene behaviour implies that the patients comply with a daily and effortful routine. The success of the treatment thus ultimately relies on patients' compliance with daily dental care. Unfortunately, empirical evidence shows that only a small proportion of the patients actually complies with the treatment. For instance, Beals et al. (2000) have reported that patients' average brushing time in the US is only 37 s. Other studies have shown that approximately 2–10% of the population floss regularly and effectively (Steward et al. 1997, Macgregor et al. 1998). Several reasons have been reported in the literature for this lack of compliance. Some studies have found a positive relationship between socio-economical status and self-esteem on the one hand, and brushing or flossing behaviours, on the other hand (Macgregor et al. 1991, 1997). Other studies have shown that several psychological constructs related to self-efficacy and to attitudes and dental coping beliefs are positively related to self-reported oral health behaviour (Tedesco et al. 1991, Steward et al. 1997, Syrjälä et al. 2001) and to lower plaque index (PI) (Wolfe et al. 1991).

Whatever the reason for this lack of compliance, given the serious consequences of chronic periodontitis, there is an urgent need to develop and validate effective strategies to improve periodontitis patients performance in applying daily prophylactic dental care (Ciancio 2003). A few studies have investigated the effectiveness of interventions designed to increase compliance with dental hygiene. For instance, Steward & Wolfe (1989) reported that two sessions of oral hygiene instruction, including corrective feedback, significantly reduced PIs within a few weeks. However, this positive effect disappeared within a year. In a study using an experimental design, Steward et al. (1997) compared the effectiveness of four treatment conditions: a cognitive behavioural intervention, an educational intervention, a placebo intervention controlling for the amount of attention received by the participants, and a control-no treatment condition. In the two sessions of cognitive behavioural intervention, participants explored the personal meaning of loss of teeth and they self-monitored their brushing and flushing behaviour as well as barriers encountered in performing this behaviour. In the educational intervention, participants received two sessions of dental education and brushing and flossing instructions with corrective feedback. Self-report of flossing and brushing increased in the three treatment groups, with no differences among these groups, but better results than the control group. Plaque level also significantly decreased in the three treatment groups and more so, in the cognitive behavioural intervention.

In sum, both correlational and clinical trial evidence suggest that psychological variables play a role in compliance with oral health behaviour. This observation justifies the design of psychological methods aiming at developing compliant behaviour. In the field of health psychology and behavioural medicine, several models have been developed to explain and improve compliance with treatment (Glanz et al. 1997, Coutu et al. 2000). One of the most studied and validated models is the self-regulation theory of Leventhal (Leventhal et al. 1992). This model postulates that people's health behaviour in response to an illness is determined by their representation of that illness. The impact of illness representation on periodontal health has been documented in several studies (e.g. Bader et al. 1990, Wolfe et al. 1991). Illness representations have a cognitive and an emotional aspect and they are constructed through direct or vicarious experiences, as well as by information received from the social environment and health professionals. In Leventhal's model, illness representations comprise five major dimensions.

The first dimension is identity, i.e. the disease label and its symptoms indicators (Croyle & Sande 1988). For instance, gingival bleeding is a typical symptom of periodontitis, while coloured teeth are not (Armitage 1995). The second dimension, labelled ''time line'' pertains to whether the disease is acute (and will disappear in time, like a flu), cyclic or chronic (Leventhal et al. 1985). The third dimension concerns the social, economic and physical consequences of the illness (Croyle & Jemmott 1989) and the fourth, the risk factors of the disease such as genetic factors, poor plaque control, etc. Last but not the least, the fifth dimension concerns the potential for cure or control (Weinstein 1988). This latter dimension is particularly important for compliance with treatment. Indeed, patients will adhere to a treatment – especially if it requires daily tedious action – only if they believe that this treatment will have a positive effect on their health and that they have the capacity to effectively act as required by the treatment (i.e. self-efficacy).

A basic assumption of the self-regulation model is that a representation that is correct on the cognitive level and not aversive on the emotional level leads to more appropriate and adaptive behaviours (Taylor et al. 1984). Such behaviours are likely to result in a positive health outcome and hence increase the sense of self-efficacy (Bandura 1977, Bandura & Locke 2003). This positive reinforcement dynamic promotes compliance.

The aim of the present study is to investigate whether a behavioural educational intervention based on the self-regulation theory can improve periodontitis patients compliance with proper dental care. A simple behavioural educational intervention was designed with two basic aims (1) ensuring that patients had a correct representation of their condition on all five dimensions of illness representation (educational part of the intervention) and (2) enhancing their sense of efficacy in acting upon the symptoms of periodontitis (behavioural part of the intervention). The latter aim was achieved via patients' daily self-observations of their symptoms and of the impact of applying the prescribed prophylactic treatment on these symptoms.

Material and Methods

A controlled clinical trial design was used in the present study. Patients suffering from periodontitis were randomly assigned to an experimental or to a control condition. In the control condition, they received the treatment regularly applied at the University consultation service of periodontology. It consists of a periodontal examination and diagnosis, extensive explanations and demonstration about the prophylactic means (toothbrushing, use of dental floss and inter-dental brushes) and a scaling/root planing. In addition, patients receive an illustrated booklet with all the prophylactic information. A month later, patients have an appointment for a follow-up periodontal check-up. For the sake of the present study, this standard treatment was completed according to the following steps.

First, at the beginning of the initial session (baseline), just after the periodontal examination, participants were asked to fill in a questionnaire assessing their knowledge of periodontitis (see description of the questionnaire). Second, at the end of that initial session, participants were asked to report on a 11-point scale, ranging from 0 (totally disagree) to 10 (totally agree), whether they believe they could change their behaviour to perform the prophylactic care daily. Third, an intermediary session was scheduled 2 weeks after the initial session. For the control group, it consisted of a re-exposition of the prophylactic means.

In the experimental condition, patients received exactly the same treatment with three additions constituting the behavioural educational intervention for compliance. The first addition consisted of a feedback and discussion about their answers to the periodontitis knowledge questionnaire, immediately after they had filled it. It was ascertained that patients in the experimental condition had perfectly correct information regarding each of the five aspects of illness representation according to Leventhal's et al. (1992) model (i.e. illness identity, causes, consequences, time course, and controllability).

The second addition was that experimental participants were requested to fill in a short diary about their compliance with the prophylactic treatment. This diary was composed of a set of specific questions: When had they fully brushed their teeth, the intensity of specific sensations after toothbrushing (gingival bleeding, sensation of well-being in the mouth, pain, presence of calculus; on 11-point scales) and how they felt they had followed instructions for toothbrushing, dental flossing, interdental brushing (also on 11-point scales). If they had not followed the instructions well, they had to fill in the reason choosing from the following items: lack of time, pain, forgetting, fatigue, stress, no motivation, other (to precise), and to propose a way to deal with this (these) difficulty(ies) in the future.

The last addition concerns the 2 weeks follow-up session. While control participants were re-exposed to prophylactic means, experimental participants discussed and analysed their diary with the experimenter. Potential progress was stressed, problems encountered were discussed, and possible solutions were elaborated.

The researchers made sure that equal amounts of contact and attention were devoted to participants from both groups.

Participants

Thirty-three volunteers (20 men and 13 women) were recruited at the University periodontology consultation service. Potential participants were proposed to participate in a study allegedly on the time required for periodontitis symptoms to remit when prophylaxis is applied. None of the individuals contacted refused to participate. The inclusion criterion was to suffer from periodontal problems, exclusion criteria were having already followed a treatment for periodontitis, or being under antibiotic or antiseptic medication. The mean age of the participants was 39 years (min. 20 years of age, max. 68 years of age). Participants were randomly assigned to one of the two experimental groups, with the constraint that each participant in a group was matched for gender, age, and level of education with a participant in the other group. Of the 33 participants, 30 (18 men and 12 women) fully completed the study, 15 in each group.

Clinical measurements PI

The extent and amount of dental plaque accumulation on the buccal, lingual and proximal surfaces of all the teeth, were assessed using a periodontal probe (PCPUNC 15-Hu-Friedy®/Chicago, IL, USA), which harvests plaque deposits found on the dental surfaces. PI (Silness & Löe 1964) were evaluated according to the following criteria: according to Silness & Löe (1964).

Psychological measurements

A self-report questionnaire based on the self-regulation theory of Leventhal (Leventhal et al. 1992) has been designed to assess the knowledge participants had of periodontitis. This questionnaire examines the five aspects of illness cognition according to Leventhal et al. (1992). For each aspect, a set of items is proposed to the participant who has to decide whether each item is typical or not of periodontitis. Among the items proposed, some are correct and some are incorrect. Each item is accompanied by an 11-point scale, ranging from 0 (totally disagree) to 10 (totally agree). A first set of 10 items addresses the symptoms that would be typical of periodontitis (see Table 2 for the list of the symptoms). The second set (12 items) pertains to the causes of periodontitis (see Table 3 for the list of the causes). Four items assessed possible consequences (dental loss, dental mobility, prosthesis placement, tooth decay), and five items addressed the time course of the illness (whether gingivitis or periodontitis are acute and transient, chronic, or cyclic conditions). Finally, the means to control the illness that participants thought they had were assessed by means of six items (see Table 4 for the list of the means of control). Participants were also asked whether their main source of information regarding periodontitis came from their dentist, magazines, radio or television, family or friends, other sources to be specified, or whether they had received no information at all.

Data analyses

The statistical program SPSS 11.0 (Chicago, IL, USA) was used for all analyses. The experimental group was treated as a fixed between-subjects factor. In all comparisons, the α level was set at $p < 0.05$. The analysis proceeded in two steps. First the treatment effects were examined, then the questionnaire data on participants' prior knowledge of periodontitis were analysed.

The main analysis regarding treatment effect consisted of a mixed-design 2×2 ANOVA computed on the mean PI as dependent measure, with time of measurement (before the psychological measurement, and at the 1-month follow-up) as within-subject factors, and experimental group as between-subjects factor. The normality of the distribution of the mean PI data was ascertained. In order to examine whether the treatment had a different impact on specific plaque location, a follow-up analysis was conducted with a mixed-design $2 \times 3 \times 2$ ANOVA computed on the three PIs (Buccal PI, Lingual PI and Proximal PI) as dependent measure, with time of measurement (before the psychological measurement, and at the 1-month follow-up) and PI location as within-subject factors, and experimental group as between-subjects factor. The effects of this analysis were specified with mixed-design 2×2 ANOVAS computed on each PI, with time of measurement as within-subject factor and experimental group as

between-subjects factor, and Student's *t*-tests were used to determine specific differences between groups. Greenhouse–Geisser correction for sphericity was used in all repeated measure analyses.

For the questionnaire data, as some items did not have a normal distribution, non-parametric Mann–Whitney *U* tests were used to determine differences between groups.

Table 1. Means and standard deviation of the plaque indices (PI) as a function of time of measurement and experimental group

Plaque index location	Time of measurement			
	baseline		1-month follow-up	
	experimental group	control group	experimental group	control group
Global	1.63a (0.43)	1.88a (0.41)	0.24ii (0.19)	0.88i (0.38)
Lingual	1.87a (0.49)	2.03a (0.41)	0.22ii (0.28)	0.84i (0.48)
Buccal	1.13a (0.55)	1.41a (0.64)	0.08ii (0.08)	0.45i (0.43)
Proximal	1.83b (0.41)	2.19a (0.40)	0.43ii (0.24)	1.34i (0.55)

Note: means with different letters (comparisons within time of measurement) indicate a difference at $p<0.05$ between experimental and control groups.

Results

Treatment effect

It should first be noted that before treatment, both groups strongly believed that they could comply with the treatment procedure and that they would apply the prophylactic care (mean of 8.8 on 0–10 scale, no difference between group). The 2×2 ANOVA computed on the mean PI revealed the expected group main effect, $F(1,28) = 16.42$, $p<0.000$, partial $\eta^2 = 0.37$, time of measurement main effect, $F(1,28) = 264.72$, $p<0.000$, partial $\eta^2 = 0.90$, and Group $\times$ Time interaction, $F(1,28) = 6.35$, $p<0.02$, partial $\eta^2 = 0.19$. Post hoc analyses indicated that while the groups did not differ before treatment [mean for experimental group = 1.61, standard deviation (SD) = 0.43; mean for control group = 1.87, (SD) = 0.41] they did differ after treatment, $t(28) = 5.80$, $p<0.000$ (mean for experimental group = 0.24, SD = 0.19; mean for control group = 0.88, SD = 0.38). Thus, it appears that while both groups improved following treatment, the experimental group improved more than the control ''treatment as usual'' group.

The $2 \times 3 \times 2$ ANOVA computed on the three PI confirmed the group main effect, $F(1,28) = 15.90$, $p<0.000$ and Group Time interaction, $F(1,28) = 7.09$, $p<0.02$, partial $\eta^2 = 0.19$. In addition, there was a tendency for this interaction to vary according to PI location as shown by the Group $\times$ Time $\times$ Type of index interaction, $F(2,56) = 2.87$, $p<0.07$. Other significant effects, of marginal interest for the present question, were the time main effect, $F(1,28) = 267.10$, $p<0.000$, indicating that both groups improved from baseline [mean = 1.73, standard error (SE) = 0.08] to the 1-month follow-up (mean = 0.56, SE = 0.06), the PI location main effect, $F(2,56) = 7.07$, $p<0.000$, as well as its interaction with time, $F(2,56) = 7.61$, $p<0.001$. The follow-up 2×2 ANOVAS indicated that the Group $\times$ Time interactions were significant for the proximal PI, $F(1,28) = 5.28$, $p<0.03$ and the lingual PI, $F(1,28) = 10.11$, $p<0.004$, but not for the buccal PI, $F(1,28) = 0.21$, NS. The cell means and standard deviation are displayed in Table 1.

As can be seen, the two groups were similar at base line for the proximal and buccal PI. However, a small difference was observed for the lingual PI, $t(28) = 2.34$, $p<0.05$, the control group showing slightly higher scores than the experimental group. In contrast, at the 1-month follow-up, the experimental group showed clearly smaller scores of all indices as compared with the control group (all $p<0.002$). Actually, the PI scores of the experimental group are close to zero, suggesting a floor effect.

Table 2. Means and standard deviation (SD) of symptom attribution to periodontitis

Symptom	Mean	SD
Gingival bleeding*	8.30	2.292
Dental mobility*	8.10	2.759
Plaque*	6.90	2.952
Gingival irritation*	6.80	3.398
Abscess*	5.77	3.401
Bad breath*	4.53	3.319
Tooth decay	3.80	3.605
Tooth wear	3.67	3.736
Tooth colouration	3.03	2.834
Wisdom tooth problems	1.57	2.661

Note:
*indicates a correct item.

Table 3. Means and standard deviation (SD) of cause attribution to periodontitis (data aggregated from both groups)

Cause	Mean	SD
Plaque*	7.73	2.677
Age	6.67	3.209
Sweets	6.57	3.350
Vitamin deficiency	6.43	3.234
Immune deficiency*	5.87	3.246
Diet	5.43	3.520
Heredity*	5.03	3.102
Tobacco*	3.93	3.638
Stress*	3.77	3.441
Common toothpaste	3.67	3.736
Hormone modification*	3.23	2.812
Tooth fillings	2.77	3.093

Note:
*indicates a correct item.

Participants' prior knowledge of periodontitis

Responses to all questionnaire items were compared between groups with Mann–Whitney *U*'s. No differences were observed, attesting that both groups had the same knowledge of periodontitis before treatment. The analysis of participants' responses revealed that their knowledge was rather good. As can be seen in Table 2, regarding symptom identity of the illness, participants clearly endorsed more correct symptoms (gingival bleeding, plaque, dental mobility, gingival irritation, abscess, bad breath) than incorrect ones (tooth decay, tooth colouration, tooth wear, wisdom tooth problems). However, as shown in Table 3, participants had a very poor knowledge of the causes of periodontitis. If they correctly endorsed ''plaque'' as the most important cause, their answer to the other items showed no discrimination between correct and incorrect causes. Regarding the consequences of periodontitis, higher acceptance ratings were reported for correct responses (dental loss and mobility, means 8.00 and 8.23; prosthesis placement, mean 6.73) than incorrect ones (tooth decay, mean 4.80). For the time course of the illness, participants reported that dental loosening increases in time (mean 7.73) and that periodontitis and dental loosening are not transient or cyclic conditions (all means under 3.00). Finally, as can be seen in Table 4, participants had only a

Table 4. Means and standard deviation (SD) of the attribution of control strategies for periodontitis (data aggregated from both groups)

Control strategy	Mean	SD
Type of tooth brush used	8.10	2.412
Dentist care*	7.77	3.002
Dental hygiene as prevention to periodontitis*	6.57	2.738
Dental hygiene as prevention to plaque*	5.67	3.356
Mouthwash	5.00	3.162
Diet	4.00	3.353

Note:
*indicates a correct item.

partial knowledge of the effective way to deal with periodontitis as they attributed rather large scores to ineffective strategies, such as the type of toothbrush or diet. It is to be noted that only 12 of the 30 patients reported having received information from their dentist and that 10 had received no information at all.

Discussion

The findings of the present study support the notion that a behavioural educational strategy based on the self-regulation theory of Leventhal (Leventhal et al. 1992) is effective in improving patients' compliance to prophylaxis. It should be noted that this improvement was observed as compared with a ''treatment as usual'' condition that comprised oral hygiene instruction and corrective feedback, and not to a non-treatment group (Steward et al. 1997). Our data also suggest that giving information and training about the correct prophylactic techniques has a positive effect. Indeed, this treatment was the only one applied to the control condition in which improvement was observed on PI. However, given the absence of a strictly ''no-treatment placebo'' group, we do not know whether the improvement observed is accounted for by information and training about the correct prophylactic techniques, or if it merely results from receiving attentive care from a dental health specialist. Indeed, in their experimental study, Steward et al. (1997) observed some improvements in their placebo control group which merely consisted of lectures on non-disease procedural aspects of dentistry following educational intervention.

Still, for two of the three PIs (proximal and lingual), patients in the experimental group improved significantly more than those in the control condition. This indicates that the behavioural educational strategy designed in this study has an added value to improve compliance as compared with an intervention simply based on information and training about prophylaxis. This finding is notable for at least two reasons. First, it has been obtained on a relatively modest sample of subjects, attesting the importance of the effect size. Indeed, the interaction between time and group – which is the most relevant effect to estimate the effect size of the treatment –explains 19% of the variance of all indices. Second, the PI means of the experimental group at the 1-month follow-up were almost back to perfection, which was not the case of the control group. This even suggests that a floor effect might have taken place, thereby limiting the effect size of the treatment: The experimental group could not have improved more than it did.

To summarize, our evidence shows that the behavioural education intervention presented in this study is (a) more effective than a classical intervention based on information and training about prophylactic techniques and (b) that it is effective in bringing most patients to acceptable plaque levels. This latter statement is further supported by an analysis of individual cases. Indeed, while before treatment, all patients had a mean PI above 0.5, after treatment, 13 of the 15 patients of the behavioural education condition had a mean PI below 0.5, but only three out of 15 presented such good results in the ''treatment as usual'' control condition.

The behavioural education intervention presented in this study comprises two aspects: education about the different aspects of periodontitis representation and development of a sense of self-efficacy via the observation of one's own action. The study design does not allow to determine whether both aspects are effective and whether their combination is necessary. Future studies could separate these components and estimate their respective contribution as well as whether their efficacy results from their interaction.

Still, the present findings have direct implications for the clinician. They show that, although partially effective, educating the patients about the proper prophylactic techniques is not enough. Better results can be obtained if (a) patients are taught a correct representation about the symptoms of periodontitis, the causes, consequences and temporal course, and the types of effective strategy upon which they can rely and (b) patients' sense of self-efficacy is developed through their own direct experience, by observing the effects of their behaviour on periodontitis' symptoms.

However, a limitation of the present study is to be acknowledged. The follow-up measure took place only 1-month post-treatment. Unfortunately, it cannot provide indications regarding the long-term effectiveness of the intervention.

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References

Armitage, G. C. (1995) Clinical evaluation of periodontal diseases. *Periodontology 2000* **7**, 39–53.

Bader, J. D., Rozier, R. G., McFall, W. T. & Ramsey, D. L. (1990) Association of dental health knowledge with periodontal conditions among regular patients. *Community Dental and Oral Epidemiology* **18**, 32–36.

Bandura, A. (1977) Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review* **84**, 191–215.

Bandura, A. & Locke, E. A. (2003) Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology* **88**, 87–99.

Beals, D., Ngo, T., Feng, Y., Cook, D., Grau, D. G. & Weber, D. A. (2000) Development and laboratory evaluation of a new toothbrush with a novel brush head design. *American Journal of Dentistry* **13**, 5A–14A.

Ciancio, S. (2003) Improving oral health: current considerations. *Journal of Clinical Periodontology* **30**, 4–6.

Coutu, M-F., Dupuis, G. H., Marchand, A., O'Connor, K., Trudel, G. & Bouthillier, D. (2000) Adoption et maintien des habitudes comportementales saines: recension des modèles explicatifs. *Revue Francophone de Clinique Comportementale et Cognitive* **5**, 23–35.

Croyle, R. T. & Jemmott, J. B. (1989) Psychological reactions to risk factor testing. In: Skelton, J. A. & Croyle, R. T. (eds). *Mental Representation in Health and Illness*. New York: Springer-Verlag.

Croyle, R. T. & Sande, J. N. (1988) Denial and confirmatory search: paradoxical consequences of medical diagnosis. *Journal of Applied Social Psychology* **18**, 473–490.

Genco, R. J., Trevisan, M., Wu, T. & Beck, J. D. (2001) Periodontal disease and risk of coronary heart disease. *Journal of the American Medical Association* **284**, 1406–1410.

Glanz, K., Lewis, F. M. & Rumer, B. K. (eds.) (1997) *Health Behavior and Health Education. Theory, Research and Practice*. San Francisco: Jossey Bass.

Leventhal, H., Diefenbach, M. & Leventhal, E. A. (1992) Illness cognition: using common sense to understand treatment adherence and affect cognition interactions. *Cognitive Psychology and Research* **16**, 143–163.

Leventhal, H., Easterling, D. V., Coons, H., Luchterhand, C. & Gutmann, R. R. (1985) Adaptation to chemotherapy treatments. In: Andersen, B. (ed.) *Women with Cancer*, pp. 172–203. New York: Springer-Verlag.

Macgregor, I. D. & Balding, J. W. (1991) Self-esteem as a predictor of toothbrushing behaviour. *Journal of Clinical Periodontology* **18**, 312–316.

Macgregor, I. D., Balding, J. W. & Regis, D. (1998) Flossing behaviour in English adolescents. *Journal of Clinical Periodontology* **25**, 291–296.

Macgregor, I. D., Regis, D. & Balding, J. W. (1997) Self-concept and dental health behaviour in adolescents. *Journal of Clinical Periodontology* **24**, 335–339.

Morris, A. J., Steele, J. & White, D. A. (2001) The oral cleanliness and periodontal health in UK adults in 1998. *British Dental Journal* **191**, 186–192.

Offenbacher, S. (1999) The link between periodontal disease and systemic health: a scientific update. Interview by Phillip Bonner. *Dentistry Today* **18**, 88–89.

Silness, J. & Löe, H. (1964) Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontologica Scandinavica* **22**, 121–135.

Steward, J. E., Strack, S. & Graves, P. (1997) Development of oral hygiene self-efficacy and outcome expectancy questionnaires. *Community Dentistry Oral Epidemiology* **25**, 337–342.

Steward, J. E. & Wolfe, G. R. (1989) The retention of newly-acquired brushing and flossing skills. *Journal of Clinical Periodontology* **16**, 331–332.

Syrjälä, A-M., Knuuttila, M. L. & Syrjälä, L. K. (2001) Self-efficacy perceptions in oral health behavior. *Acta Odontologica Scandinavica* **59**, 1–6.

Taylor, S. E., Lichtman, R. R. & Wood, J. V. (1984) Attributions, beliefs about control, and adjustment to breast cancer. *Journal of Personality and Social Psychology* **46**, 489–502.

Tedesco, L. A., Keffer, M. A. & Fleck-Kandath, C. (1991) Self-efficacy, reasoned action, and oral health behavior reports: a social cognitive approach to compliance. *Journal of Behavioural Medicine* **14**, 341–355.

Weinstein, N. (1988) The precaution adoption process. *Health Psychology* **7**, 355–386.

Wolfe, G. R., Stewart, J. A. & Hartz, G. W. (1991) Relationship of dental coping beliefs and oral hygiene. *Community Dental and Oral Epidemiology* **19**, 112–115.

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