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Application of self-regulation theory and motivational interview for improving oral hygiene: a randomized controlled trial

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Abstract

Aim: Because patient adherence to oral hygiene is essential for periodontal treatment success, the aim of the study was to assess whether a motivational interview addressing the five dimensions of Leventhal's theory performed better than conventional basic instruction on improving compliance with plaque control among patients with periodontitis.

Materials and Methods: A randomized controlled clinical trial design was used in which a group of patients underwent a motivational interview in addition to classical consultation. A control group received only the standard consultation. The O'Leary Plaque Index was used to judge the oral hygiene at baseline and at 1 month follow-up. Patient satisfaction with the dental visit was scored using a specific questionnaire.

Results: At baseline, the mean full mouth plaque score varied between 55% (experimental group) and 58% (control group). Patients in the experimental group had a higher oral hygiene improvement (21 ± 20% *versus* 4 ± 5%, $p < 0.001$) 1 month post-treatment. The motivational interview resulted in greater satisfaction scores compared with those of patients in the control group: 10.55 ± 1.53 *versus* 8.82 ± 2.40, $p = 0.014$.

Conclusions: This new concept of motivational interview is a promising approach and can be useful for counselling-related periodontal disorders.

Key words: behaviour change; compliance; motivational interview; oral hygiene behaviour; periodontitis

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Periodontal diseases affect health both from an oral health perspective and systemically (Scannapieco et al. 2010). Based on the International Classification of Periodontal Diseases (Armitage 1999), 50% of adults in France may suffer from a severe attachment loss problem (Bourgeois et al. 2007). Positive correlations between inflammation and plaque and loss of attachment and plaque have been reported (Waerhaug 1977). Therefore, oral hygiene plays a major role in the success and efficiency of periodontal treatments by the combination of brushing, flossing and use of inter-dental aids and chemical agents when needed. Unfortunately, most patients are not completely effective at plaque removal (Philippot et al. 2005). According to Checci et al. (1994), adherence to periodontal therapy and maintenance generally decreases with increasing time since treatment, and even the most meticulous periodontal therapy may be ineffective. Motivating patients to adhere to periodontal treatment continues to be difficult among a large percentage of patients. Adherence to an oral hygiene regimen is becoming more important now that a larger proportion of people retain their teeth until later in life. Also, the greater use of implant technology means that effective oral hygiene is a prerequisite for successful treatment.

Conflict of interest and source of funding statement

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There is a great need in dentistry for effective interventions to improve patient compliance with oral hygiene instructions (Ohrn & Sanz 2009, Renz & Newton 2009, Newton 2010).

The definition of compliance is the extent to which a person's behaviour coincides with medical or health advice (Sackett & Haynes 1976). Different reasons have been advanced in the literature to explain levels of compliance: There is a positive relationship between socioeconomic level and self-esteem on one hand and brushing and flossing on the other (Macgregor & Balding 1991, Macgregor et al. 1997). Patients fail to adhere because of self-destructive behaviour (Farberow 1986), fear, economic factors, health beliefs stressful events in their lives, lack of pertinent information, and perceived indifference of the dentist (Wilson 1998). Whatever the causes of this lack of adherence, the consequences to periodontal health are important.

Many studies have shown the efficacy of interventions aimed at improving compliance to oral health guidelines. Steward and Wolfe reported that two sessions of oral hygiene instruction, including corrective feedback, significantly reduced the patients' plaque scores in a few weeks; however, the improvement disappeared within 1 year (Stewart & Wolfe 1989). Wilson et al. also showed that compliance increased when the practitioner made instructional efforts (Wilson et al. 1993). Moreover, clinical trial evidence suggests that psychological variables play a role in adherence in oral health behaviour (Hugoson et al. 2007) and using cognitive behavioural interventions gives good results (Philippot et al. 2005, Jonsson et al. 2006, Kakudate et al. 2009). This observation justifies the design of psychological methods to develop adherence 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). Among several models, such as the Health Belief Model (Rosenstock 1966, 1974), the Theory of Reasoned Action (Fishbein & Ajzn 1975), and the Self Efficacy Model (Bandura 1977), the self-regulation theory of Leventhal (Leventhal & Cameron 1987) seems to be of interest for oral compliance. This model postulates that people's health behaviour in response to an illness is determined by the representation of their illness. In Leventhal's model, illness representations comprise five major dimensions: The first is identifying the disease label and its symptomatic indicators. The second, labelled "time line," pertains to whether the disease is acute, cyclic, or chronic. The third concerns the social, economic and physical consequences of illness. Fourth are the risk factors of the disease, such as genetic factors or poor plaque control. The fifth and final dimension concerns the potential for cure or control (Leventhal & Diefenbach 1992). Applying Leventhal's theory in a behavioural or educational intervention significantly ameliorates oral hygiene (Philippot et al. 2005). This improvement can be explained by a better perspective on the part of the patient regarding the illness, its symptoms and possible symptom diminishment with new effective behaviour. In the 1980s, a communication methodology designated as the "motivational interview" was developed which has been defined as a "client-centered directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence" (Miller & Rollnick 2006). The study of addictions and tobacco habits used this kind of intervention and noted good effects on patient compliance. This type of interview seems to include principles similar to those described by Alcouffe a few years ago and applied to oral hygiene motivation (Alcouffe 1988). A systematic review and meta-analysis of randomized controlled trials showed that motivational interviewing outperforms traditional advice providing (Rubak et al. 2005). A randomized clinical trial confirmed that the motivational interview enhanced the preventive behaviour of mothers of young children at high risk of developing caries (Weinstein et al. 2006). Moreover, it has been applied in periodontology with good results (Ramsier et al. 2008). The motivational interview has proven very effective in consultations in which ambivalence and motivation are central to the process of change. Open questions regarding patient support and value, and listening to, summarizing and restating sentences are key principles in motivational interview. However, it is essential to develop methods which are easy to implement and without excessive additional time.

The aim of this study was to assess whether an original motivational interview addressing the five dimensions of Leventhal's theory performed better than conventional basic instruction to improve compliance with plaque control among patients with periodontitis. The experimental group was hypothesized to show a significantly greater decrease of plaque index than control group.

Materials and Methods

This study followed a randomized controlled clinical trial design. The study was conducted at the department of Periodontology of Rennes' University Hospital during the period from January 2009-March 2010. Patients suffering from periodontitis and visiting at the Department of Periodontology for the first time were asked to participate in a study assessing the quality of their plaque control. Each patient gave signed informed consent. The Ethics Committee of the Medical College from Rennes Hospital approved the study. The CONSORT guidelines for clinical trials were followed. Inclusion criteria were as follows: patients with moderate-to-severe chronic periodontitis (Armitage 1999) who had never received periodontal treatment or been taught the brushing technique, and who were considered fit regarding physical capacity to implement hygiene measures and regarding intellectual capacity to understand the pathological mechanisms of periodontal disease. Participants were randomly allocated to either an experimental group (motivational interview in addition to standard treatment programme) or a control group (standard treatment programme). Allocation concealment was secured with sealed, opaque envelopes containing only the assignment for an individual participant. The flow of envelopes was randomized by mixing all envelopes before the beginning of the study. The two operators involved in the study (S. J., A. G.) had

not met the patients before the assignment and opened the envelope containing group allocation in front of the patient.

Organization of Sessions

Two experienced periodontists provided both interventions (S. J., A. G.). In the control group, patients received oral hygiene instruction and care as usually practiced in the service, including a demonstration of oral self-care prevention (brushing, flossing and inter-dental brushing on a model, as well as demonstration in the mouth with a mirror), and scaling/polishing. Patients also received an illustrated booklet of information on prophylaxis and periodontal disease.

In the experimental group, patients received the motivational interview guided by Leventhal's theory. The two operators involved in the study (S. J., A. G.) were introduced to the practice of motivational interviewing. The motivational interviews were approximately 15–20 min. long, about the same time as the control group consultation. Oral hygiene information and instruction were given to the patient during the motivational interviewing (depending on the patient). This type of interview does not require really more time than a conventional consultation.

Motivational Interview

A questionnaire prepared for the study by the two operators was used as a basis for initiating the interview. The interview moved from patient responses to each question, taking the lead from these responses to summarize and restate patient answers. This questionnaire follows the principles of motivational interviewing (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. The questionnaire consisted of five questions:

1. What symptoms led you to consult the service for gum disease?
2. How long have you had gum problems?
3. What consequences have your gum problems had in your everyday life?
4. What kind of oral care do you make regularly, even daily, for your gums, and what factors may increase your gum problems?
5. What treatments do you want to have to restore healthy teeth and gums?

Thus, the explanation of preventive methods was addressed naturally during the ensuing discussion that ensued (e.g. effective brushing technique, appropriate instrumentation). One month later, patients had a follow-up appointment for a periodontal examination. During the evaluation at 1 month, a new motivational interview approach was used to address the difficulties encountered during brushing, and to make impressions on the patient about improving the symptoms of the illness.

Clinical Measures

The extent and amount of dental plaque accumulation on the buccal, lingual and proximal surfaces of all teeth (three values per tooth) were assessed visually after the use of plaque exposure (Dentoplaque® Inava), and recorded using the O'Leary Plaque Index (PI); − absence of plaque, + presence of plaque (O'Leary et al. 1972). The extent of dental plaque accumulation on initial and reevaluation days was performed by one practitioner of the service who did not participate to the study and did not know the group membership.

Psychological Measures

An empirical three dimensional structure of satisfaction was described for dental visit (Corah et al. 1984). As we just wanted to evaluate the communication and information satisfaction, we retained only the first part of this specific scale. This resulted in an original, anonymous questionnaire of satisfaction (established in dialogue by both operators) coded according to the group. It was given to patients at the end of the first session.

Patients assessed three affirmations, assigning a number to each (1, not at all; 2, very little; 3, medium; 4, absolutely). The numerical responses to each item provided a score that assessed patient satisfaction with their understanding of the disease and its possible evolution. Questionnaires were collected by the service's secretary at the beginning of the second session.

Statistical Analyses

All analyses were done on an intention-to-treat basis, with missing data imputed as the same as data from the inclusion session. The statistical analysis included a descriptive analysis of the population, consisting of the mean and standard deviation for quantitative variables and percentage for qualitative variables. The normality of the distribution of the data was ascertained before further analyses were undertaken. Statistical comparisons of the means were carried out using a Wilcoxon signed-ranks test (paired tests were used when necessary), and comparisons of quantitative variables were done using a χ^2 or a Fischer's exact test when numerical values were not sufficient. Variables were also tested two by two to identify interacting and confounding factors.

The analysis of treatment effect consisted of a mixed-design, 2×2 ANOVA computed with the mean PI as the dependent measure, with time of measurement as the within-subjects factor and experimental group as the between-subjects factor: the statistical unit was the patient. A $2 \times 3 \times 2$ ANOVA with the mean PI at the site location as the dependent measure was also computed, with time of measurement and PI location as within-subjects factors and experimental group as the between-subjects factor: the statistical unit was the patient. Post hoc analyses were conducted using the Tukey HSD test.

The significance level was set at 5%. Statistical analyses were blind to group status. All data were analysed using R software version 2.11.1 (The R Foundation for Statistical Computing).

Sample Size Calculation

The size of the required sample to detect a true difference of 15% in PI between test and control with 90% power and with an α error of 0.05 was estimated by running a pre-study on 18 patients. Results of the

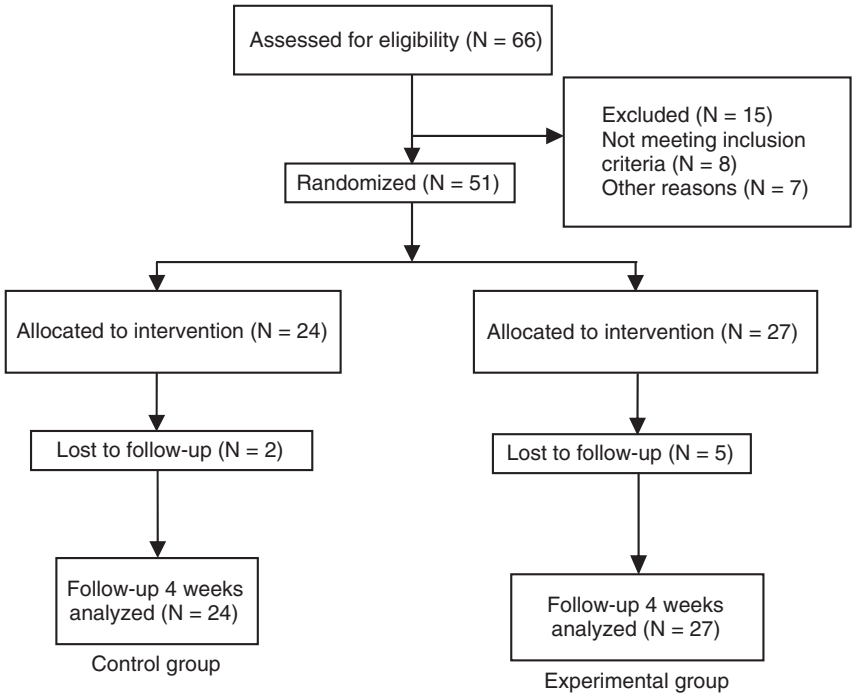

Fig. 1. CONSORT flow chart.

pre-study indicated that a total of 42 subjects with complete data were required and the 18 patients of the pre-study were included in the main study.

Results

Figure 1 presents the study flow chart. A total of 51 patients were included in this study, and Table 1 summarizes patient characteristics. Table 2 presents mean PIs (±SD) by surfaces. Whole mouth mean PIs was 0.55 ± 0.15 at baseline and 0.34 ± 0.20 1 month later, for the experimental group. For the control group, whole mouth mean PIs was 0.58 ± 0.12 at baseline and 0.54 ± 0.12 1 month after treatment. There was no statistically significant difference in PI values at baseline.

Table 1. Participants' characteristics

	Experimental group	Control group
No. of participants	24	27
Gender (female/male)	11/13	12/15
Smokers	11	13
Mean age, years (±SD)	51.6 (±16.6)	48.3 (±16.5)
Number of teeth (±SD)	25.6 (±5.0)	26.6 (±3.8)

Table 2. Means (%) and standard deviations (±SD) of the plaque indices (PIs) as a function of time of measurement and experimental group

PI location	Time of measurement			
	Baseline		Follow-up	
	Experimental group	Control group	Experimental group	Control group
Lingual	35 (±0.23)	37 (±0.23)	18 (±0.20)	27 (±0.16)
Buccal	58 (±0.28)	59 (±0.19)	29 (±0.29)	43 (±0.22)
Proximal	65 (±0.22)	68 (±0.23)	45 (±0.30)	73 (±0.27)

Tests for confounding factors revealed no effect of age, number of teeth, gender, or tobacco smoking on the study results.

The results of the 2×2 ANOVA computed on the mean PI revealed a group main effect ($p = 0.01$), a time of measurement main effect ($p = 0.003$), and a group/time interaction ($p = 0.004$). Post hoc analyses revealed that mean PI did not differ before treatment ($p = 0.86$) but did differ after treatment ($p < 0.001$), indicating that while both groups improved their mean PI values after treatment ($p = 0.003$ for the control group, $p < 0.001$ for the experimental group), the experimental group performed significantly better than the control group ($p < 0.001$).

The results of the $2 \times 3 \times 2$ ANOVA also revealed a group main effect ($p = 0.009$), a time of measurement main effect ($p = 0.03$), and a group/time interaction ($p = 0.001$). In addition, there was a PI location effect ($p < 0.001$) and a tendency for a group/time–PI location interaction ($p = 0.07$), indicating that PI varied in different ways depending on the location and the group. Post hoc analyses confirmed this finding: all PI values improved ($p < 0.001$) except in the proximal surfaces of the control group ($p = 0.12$). The experimental group showed an improvement of $21 \pm 20\%$ *versus* $4 \pm 5\%$ for the control ($p < 0.001$).

The results of the satisfaction questionnaire are presented in Table 3. Patients in the experimental group reported greater satisfaction scores than patients in the control group: 10.55 ± 1.53 *versus* 8.82 ± 2.40, $p = 0.014$.

Discussion

The present study aimed to evaluate the effect of an original motivational interview addressing the five dimensions of Leventhal's theory on behavioural changes in oral hygiene compliance among patients with periodontitis. It is possible to measure home-care efficiency by examining the level of bacterial plaque, so the PI was used here as an outcome measure to monitor daily oral hygiene practice. Our results showed that the experimental group performed better than the control group, indicating that behaviour

Table 3. Satisfaction scores (mean ±SD)

Question	Satisfaction scores	
	Control group	Experimental group
1. After talking with the dentist, I know the health of my teeth.	2.95 (±0.90)	3.77 (±0.43)
2. After talking with the dentist, I have a good idea of possible changes in my oral health I can expect in the coming months.	3.23 (±0.75)	3.36 (±0.73)
3. The dentist told me everything I wanted to know about my teeth.	2.64 (±1.65)	3.41 (±0.67)

could not be changed by educational information alone. These findings are in line with those of other studies in which the controls groups exhibited virtually no change (Alcouffe 1988, Little et al. 1997) Because no confounding factors were found, meaning that the gender, the age, the number of residual tooth and the smoking status did not interfere with the level of PI before and after intervention, there should be no risk in generalizing from these results.

A Cochrane systematic review (Renz et al. 2007) identified some studies that compared psychological interventions with standard care in people with periodontal diseases. Stewart et al. (1991) compared the effectiveness of three kinds of interventions on oral hygiene, and found a significant difference in plaque levels between the control group (no intervention) and experimental groups. In addition, plaque levels in the cognitive behavioural group were significantly lower than those in the educational group. Little et al. (1997) found the greatest decline in plaque scores in an experimental group (group behavioural intervention) compared with a control group (usual periodontal care), the latter showed no difference at baseline and 4 months later. Stewart et al. (1997) demonstrated a significant increase in the self-efficacy of brushing and flossing following psychological intervention to improve oral hygiene behaviour and also observed that psychological intervention plus educational intervention produced a significantly greater increase than educational intervention alone. More recently, a clinical trial study demonstrated the positive effect of a behavioural educational intervention based on the self-regulation theory of Leventhal on periodontitis patients' compliance. The authors observed a stronger improvement of plaque scores for the experimental group compared with the control group although both groups improved from baseline. However, the authors noticed that because there was no group control that did not receive any treatment it was not possible to determine the method's real impact (Philippot et al. 2005).

In our study, the PI differences between the two groups were most pronounced for the proximal sites. This result agreed with other behavioural studies in patients with periodontal disease, which revealed increases in inter-dental cleaning frequency (Philippot et al. 2005, Jonsson et al. 2010). The motivational interview seems to have a greater effect on the frequency of daily inter-dental cleaning, although we did not evaluate oral hygiene habits in this study. In dentistry, compliance tends to be poor among patients who have chronic diseases that they perceive to be non-threatening (Tsami et al. 2009, Miyamoto et al. 2010). Therefore, psychological treatment in the form of the individual motivational interview should exert an observable and durable influence on oral hygiene habits. Motivational interview is a particular way of helping patients recognize and have an active behaviour about their current or potential problems. One of the principal advantages of verbal information of the patient is the opportunity to institute a communication between the patient and the dentist and to gain his trust (Miller & Rollnick 2006). Such analysis enable clinicians to distinguish between individuals who lack the motivation to change their oral hygiene behaviour and those who are so motivated but require support in planning and maintaining behavioural change. The motivational interview is a single method for behavioural change counselling in periodontal treatment (Ramsier et al. 2008).

Our study had several limitations. First, all patients had a high level of PI at baseline, and therefore potentially stood a good chance of improving. However, our results revealed that initial plaque level was not correlated with the amount of improvement ($r = 0.21$, $p = 0.15$). Secondly, even if the extra time spent with the participants of motivational interview was estimated at less than a few minutes, it was not really controlled. On the other hand, it could be considered that a 15–20 min. intervention was not long enough but according to a meta-analysis, when using motivational interview in brief encounters of 15 min., 64% of the studies showed an effect (Rubak et al. 2005). Thirdly, the study was conducted by two examiners who strictly adhered to the scheduled interview, but without inter- and intra-examiner reliability control. This could, unfortunately, induce bias in this study. It would have been more relevant to have a placebo-control group in which any additional time would have been controlled. The same operator should have conducted this intervention. Finally, it should be checked if the results of this study could be attributed only to the nature of the intervention. Therefore, to confirm the external validity of the method, it is necessary to test it with different care providers and in other dental clinics.

The long-term effect of the motivational interview cannot be evaluated because our study had a short follow-up period (1 month). While we are encouraged by the positive benefit in behavioural outcomes in our study, a longer follow-up period is clearly needed with a larger study group (our study presented a relatively modest sample of participants). However, the importance of supportive periodontal treatment for patients with periodontal diseases is well known (Konig et al. 2001). In periodontology, the rate of compliance in long-term therapy is less than 50% (Berndsen et al. 1993). Some studies have measured the effects of efforts to improve patient compliance during routine supportive periodontal therapy. The main finding of these studies was an

increase in complete compliance (Wilson et al. 1993, Jonsson et al. 2009b). When patients adhere to suggested supportive periodontal treatment schedules, more of them keep their teeth over long periods of time (Wilson 1996).

Morris and Schulz reported in their literature review that patient satisfaction turned out to be the only significant predictor of compliance (Morris & Schulz 1992). This statement implies that information about the level of satisfaction with a specific situation is more informative about the tendency to adhere than is information about a general characteristic, such as the general tendency to adhere (Albrecht & Hoogstraten 1998). For this reason, we investigated patient satisfaction with the dental visit using a specific questionnaire. Patients in the experimental group had greater satisfaction scores; scores for each question revealed a better perception of the disease and a greater awareness of the need for treatment. However, no correlation was found between these scores and the decrease in PI.

Assessment of patient behaviour and the application of effective behaviour change counselling methods appear essential to clinical concepts of periodontal care. The motivational interview can be used at an individual level to target and modify inappropriate behaviour and can be implemented into a periodontal treatment plan tailored to individual patients' needs. Although an understanding of and training in motivational interviewing based on Leventhal's methods represent an additional requirement for the periodontist, the experimental group exhibited a significantly greater decrease of plaque index than control group. This study showed a significant improvement in oral hygiene performance and patients' general satisfaction.

This new concept of motivational interview is a promising approach and can be useful for counselling-related periodontal disorders.

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Clinical Relevance

Scientific rationale for the study: Adding psychological treatment to periodontal treatment may influence oral hygiene habits. For the first time, the model of an individual motivational interview combined with Leventhal's method was adapted to periodontology, followed by evaluation of patient satisfaction.

Principal findings: Patients undergoing a motivational interview exhibited greater oral hygiene improvement compared with the control group, with significant compliance improvement.

Practical implications: This new concept of motivational interview is very promising. The authors recommend it as a new tool for dentists. This procedure could be applied in similar clinical settings when the patient's active role is crucial to treatment success.