

EFFICACY OF FOUR MOTIVATIONAL TECHNIQUES FOR IMPROVING ORAL HYGIENE: THREE-YEAR FOLLOW-UP OF A RANDOMIZED CONTROLLED TRIAL



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PURPOSE. The aim of this randomized controlled trial with blinded examiner was to compare the efficacy of four different methods of enhancing oral hygiene motivation in: (i) reducing the full-mouth plaque score (FMPS) and full-mouth bleeding score (FMBS), (ii) modifying patient behaviour, (iii) amount of intervention time required, and (iv) the degree of patient satisfaction at three-year follow-up.

MATERIALS AND METHODS. In a private practice, 100 subjects aged 18-75 years with at least 20 teeth/implants and a FMPS $\geq 40\%$ were consecutively recruited. At baseline, subjects were randomly allocated to four different oral hygiene motivational techniques: standard oral hygiene instructions (SOHI), reading a pamphlet (P), watching a video (V), or Brief Motivational Interviewing (BMI). For each method the outcome variables considered were: reduction in FMPS, reduction in FMBS, frequency of daily tooth brushing, frequency of daily flossing, motivational intervention time, degree of patient satisfaction, patient perception of oral health (by means of a questionnaire), and number of teeth lost. A single operator carried out all motivational sessions and/or professional oral hygiene at baseline and at 1, 3, 6, 12, 18, 24, 30 and 36 months. Another operator, blinded to the motivational method used, recorded the variables at baseline and at 6, 12, 18, 24, 30, and 36 months.

RESULTS. At 36-month follow-up, there had been 3, 6, 5 and 2 drop-outs for SOHI, P, V, and BMI, respectively. The reduction from baseline in FMPS was 19.7 for SOHI, 20.0 for P, 23.7 for V, and 29.9 for BMI. The difference between BMI and P was significant, a difference of 10.3 favouring BMI; 95%CI from 0.0 to 10.3; $P = 0.0445$. There were no significant differences between the four tested methods in FMBS reduction from baseline (2.1 for SOHI, 3.2 for P, 2.3 for V, and 3.6 for BMI; $P = 0.9716$), degree of patient satisfaction ($P = 0.1605$), improvement in perception of oral health ($P = 0.3305$), frequency of daily flossing ($P = 0.1991$), or number of teeth lost ($P = 0.2847$). The frequency of daily tooth brushing significantly increased after BMI compared to SOHI (the difference between BMI and SOHI was 0.6; 95%CI from 0.2 to 1.0, $P = 0.0017$). The total time required for motivation was significantly greater for the BMI as compared to all other techniques ($P < 0.0001$).

CONCLUSIONS. All tested methods improved FMPS and FMBS, and were appreciated by all subjects. The reduction in FMPS was higher with BMI than with P. The change in patient behaviour (frequency of daily tooth brushing) was more pronounced in the BMI group, but the intervention time required was greater than for the other techniques.

CONFLICT OF INTEREST STATEMENT. The authors completely self-funded the study, and there are no conflicts of interest to declare.

INTRODUCTION

The quality of home oral hygiene and patient compliance is fundamental for preventing and treating oral diseases and maintaining long-term oral health¹⁻¹¹. However, some studies^{12,13} on the effectiveness of oral hygiene motivation have shown that patient adherence to a programme of home and professional periodontal maintenance remains generally poor over time¹³⁻¹⁵. Unfortunately, there is little evidence in the dentistry and periodontology literature on the effectiveness of tools to increase the motivation and quality of oral hygiene practiced at home¹⁶⁻¹⁹.

Patient-centred counselling techniques²⁰⁻²⁹ can replace the traditional methods of motivation, inducing behavioural change. Motivational interviewing (MI)^{26,30,31} is a “collaborative, person-centred form of guiding to elicit and strengthen motivation for change”. MI has been shown to be effective for achieving behaviour changes related to obesity, drug rehabilitation, physical fitness, mental health, glycaemic control for diabetics, smoking cessation, treatment of alcoholism, HIV/AIDS, drug abuse, medication adherence, gambling, and eating disorders^{26,28,29,32-36}.

The Brief Motivational Interview (BMI) features a reduced number of sessions and specific tools provided, potentially allowing dental office staff to administer MI without the support of a psychologist^{26,30} and with reasonable cost. However, although MI has proved to be an effective method of counselling for lifestyle change, there is insufficient and controversial information on the use of BMI in dental and periodontal supportive therapy³⁷⁻⁴⁷.

We recently published one and two-year follow-up data from a randomized controlled trial comparing four different methods of motivation to oral hygiene^{48,49}. This indicated that BMI is able to change patient behaviour, significantly improving the frequency of daily tooth brushing with respect to standard oral hygiene instructions (SOHI) and video (V) methods. Nevertheless, BMI did not lead to a significant difference in FMPS and FMBS with respect to the other oral hygiene motivation methods⁴⁹. The aim of this paper is to present the results of this randomized, examiner blinded, controlled trial of the four different methods of motivation to oral hygiene at three years of follow-up.

MATERIALS AND METHODS

Trial design

This is a single-centre, parallel, randomized controlled trial with 4 arms, with an allocation ratio of 1:1:1:1 to the four motivational techniques, and a blinded examiner.

The study was conducted according to the recommendations of the CONSORT Statement for improving the quality of randomized clinical trials⁵⁰.

Eligibility criteria for participants

Study participants were recruited from patients undergoing recall sessions for professional oral hygiene. All had already been provided with instructions on how to maintain oral hygiene at home, but nevertheless presented high dental plaque index scores (FMPS greater than 40%).

Inclusion criteria were:

- Age between 18 and 75 years;
- Presence of at least 20 teeth and/or implants (pontics were not considered);
- FMPS higher than 40%.

The exclusion criteria were:

- Subjects with disabilities or unable to understand the tested motivational techniques;
- Patients receiving chemotherapy for neoplastic diseases;
- Women with ongoing pregnancy at baseline;
- Subjects suffering from diseases that could affect the frequency of their attendance.

Setting and locations

Participants were consecutively recruited from patients attending a private dental practice in Campi Bisenzio, Italy. The investigators explained to the patients the nature, aim, and methods of the trial, anticipating potential benefits, risks, and any form of discomfort that participation might entail. The patients read and asked questions inherent to the study prior to signing informed consent.

Interventions

Four methods of oral hygiene motivation were compared:

- Standard oral hygiene instructions (SOHI), chairside instruction on toothbrushing and interproximal cleaning techniques;
- Pamphlet (P), home reading of a 20-page printed pamphlet (text and images). The pamphlet had the same content as the video given to the video group;
- Video (V), home viewing of a 20-minute video. A DVD containing the educational video was given to the patients. The video illustrated the potential risks of undisturbed accumulation of plaque in the oral cavity, and the proper techniques for both tooth brushing (roll technique) and use of dental floss and/or toothpicks. The video had the same content as the pamphlet given to the P group;
- Brief Motivational Interviewing (BMI), this method was based on motivational interviewing *key concepts* (i.e., the importance of changing behaviour, the confidence to be able to do so [self-efficacy], and the willingness to change) and *primary activities* (i.e., open questions, active listening, clarifying and summarizing, and negotiating goals and strategies). BMI *primary activities* were administered by *appropriate tools*, namely a) a questionnaire on "importance" and "trust"; b) a diary of objectives, strategies to achieve them, and goals; and c) a home oral hygiene diary^{27,30}.

At baseline, a single dental hygienist with over 10 years of experience (MG), assessed whether participants met the inclusion criteria. The same dental hygienist carried out all the motivational sessions and professional oral hygiene procedures required at baseline and at the scheduled recalls (one, two, three, six, 12, 18, 24, 30, and 36 months).

All participants were given (by MG) a questionnaire to complete at baseline, and were randomized to one of the four groups according to the corresponding number: 1 (SOHI), 2 (P), 3 (V) or 4 (BMI), contained within a sealed envelope. At each session, the time required to perform the randomly allocated motivational procedure was recorded on a chronometer. Patients were re-assessed at 1 and 3, 6, 12, 18, 24, 30, and 36 months, repeating the motivational technique each time.

During each follow-up session, the instructions delivered to the patient at baseline were discussed; at all scheduled recalls, the dental hygienist (MG) reinforced the previously delivered motivational techniques. For patients allocated to the SOHI group, the dental hygienist reinforced the notions on cleaning techniques; with P and V group patients, the dental hygienist conducted an interview on the content of the two methods; and with the BMI group the

dental hygienist reinforced the relevant strategies. Professional cleaning was performed as needed at 6, 12, 18, 24, 30, and 36 months.

Outcome measures

An assessor (UP) blinded to the selected treatment recorded all outcome measures. The examiner was subjected to an intra-rater agreement test for plaque, resulting in a kappa score of 0.85, considered almost perfect agreement⁵¹.

At the scheduled visits of 6, 12, 18, 24, 30 and 36 months, the examiner (UP), blinded to the administered tested motivation technique, recorded the following clinical variables:

- Plaque accumulation at six sites per tooth/implant⁵² to calculate the Full-Mouth Plaque Score (FMPS). The examiner used a 3.2x magnification system and a staining liquid to detect the presence of plaque at each site assessed;
- Bleeding on probing at six sites per tooth/implant⁵³ to calculate the Full-Mouth Bleeding Score (FMBS);
- Frequency of daily tooth brushing, as reported on the questionnaire;
- Frequency of daily flossing, as reported on the questionnaire;
- Patient satisfaction with the given technique (assessed on a VAS from 0 to 10), as reported on the questionnaire;
- Patient perception of their own oral health level (assessed on a VAS from 0 to 10), as reported on the questionnaire;
- Number of teeth lost.

The time required for each motivational session was recorded, and the total time spent for this purpose was recorded for each patient by the dental hygienist unblinded.

Sample size

Considering $\alpha = 0.05$, a power of 80%, a standard deviation of 10 in FMPS²² and 10 as a clinically significant difference, 17 patients per group were required. This number was increased to 25 per group, making a total of 100 subjects, due to the possibility of drop-outs and in order to make multiple comparisons.

Random sequence

A computer-generated list of random numbers was used for participant allocation. A blocked randomization was applied to allocate 25 patients to each of the four treatment groups.

Allocation concealment

The allocation sequence was concealed from the researcher (MN) enrolling and assessing participants in sequentially numbered, opaque, sealed, and stapled envelopes. Only after the patient was examined at baseline, did the operator (MG) open the envelopes.

Blinding

Even though the operator and the patient were aware of the allocated arm, the outcome assessor was kept blinded to the allocation.

Statistical analysis

Descriptive statistics were performed using mean and standard deviation for quantitative data and frequency and percentage for qualitative data. The statistical unit of the analysis was the patient.

Analysis of variance (ANOVA) was performed for the outcome variables: patient satisfaction, number of teeth lost, and total motivation time. Analysis of covariance (ANCOVA) was performed for the outcome variables: change in FMPS, change in FMBS, change in daily flossing, change in daily brushing, and change in perceived health. Value at baseline was the covariate. The interaction term (treatment x covariate) was added to the model only if significant.

In the event of statistical significance (ANOVA or ANCOVA), Tukey's HSD test for multiple comparisons was carried out with 95% confidence intervals of the differences between treatments.

The intention-to-treat method of analysis was utilized. The statistical software was JMP v. 13 [SAS Institute Inc, Cary, NC].

RESULTS

One hundred participants were consecutively enrolled in the trial, and randomly allocated to the four experimental groups. As a consequence, 25 patients each underwent the four different motivational approaches, namely standard instructions on oral hygiene (SOHI), pamphlet (P), video (V), and Brief Motivational Interviewing (BMI). Patients were recruited and treated at a private practice from September to December 2011. Baseline patient characteristics are shown in **TABLE 1**. There were no apparent baseline imbalances between the four groups, except that more females were randomly allocated to the BMI group. The final 36-month follow-up was performed in December 2014.

Three patients from the SOHI group dropped out: one at six months and two after 12 months declined to return to the follow-up visit. Two patients from the P group dropped out: one at one month and one after 12 months declined to return to the follow-up visit. Nine patients from the V group dropped out (two at 1-month follow-up moved to another city, four at 3-month follow-up, one at 6 months, and two at 30 months declined to return to the follow-up visit). Five patients from the BMI group dropped out: one at 1 month for severe depression, one at 6 months, and three at 30 months declined to return to the follow-up visits. In addition, 16 patients did not attend at the 30-month visit but did attend at the 36-month follow-up. Three of these patients belonged to the SOHI group, six to the P group, five to the V group, and two to the BMI group.

There were no deviations from the protocol.

Results at 6, 12, 18, and 24 months have been reported in previous publications^{48,49}, while descriptive results at 30 months are shown in **TABLE 2**. Descriptive and inferential statistics at 36 months are shown in **TABLE 3**. At 36-month follow-up, the improvement from baseline in terms of FMPS was substantial in all groups (19.7 for SOHI, 20.0 for P, 23.7 for V, and 29.9 for BMI). There was a significant difference in improvement in FMPS between BMI and P, a difference of 10.3, 95%CI from 0.0 and 20.6, $P = 0.0445$.

In terms of FMBS, the changes were moderate (2.1 for SOHI, 3.2 for P, 2.3 for V, and 3.6 for BMI), with no significant differences among the four methods ($P = 0.9716$).

The change in daily frequency of tooth brushing was null for SOHI and V, while the BMI groups showed an increase of 0.5. The frequency of daily tooth brushing was significantly higher in the BMI group as compared to the SOHI group (the difference between BMI and SOHI was 0.6; 95%CI from 0.2 to 1.0, $P = 0.0017$).

The improvement in daily flossing frequency was null or very low in all 4 groups, and the difference was not statistically significant ($P = 0.1991$). The patient satisfaction score (assessed on a scale from 0 to 10) for the given technique was high for all groups, and the differences were not significant ($P = 0.1605$).

TABLE 1 CHARACTERISTICS OF THE 4 GROUPS AT BASELINE

Variable	Group SOHI n = 25	Group P n = 25	Group V n = 25	Group BMI n = 25
Age (years)	45.1 (12.7) [18; 64]	44.7 (14.0) [19; 66]	42.3 (12.2) [20; 65]	48.8 (13.7) [24; 73]
Gender (females)	15 (60%)	10 (40%)	16 (64%)	20 (80%)
Smokers	8 (32%)	8 (32%)	6 (24%)	8 (32%)
FMPS	65.6 (11.2)	66.4 (11.6)	64.8 (11.3)	68.5 (10.0)
FMBS	5.7 (4.6)	7.4 (5.2)	5.1 (3.5)	7.4 (4.2)
Tooth brushing (times per day)	2.1 (0.5)	2.1 (0.6)	2.5 (0.6)	2.0 (0.5)
Flossing (times per day)	0.8 (0.6)	0.7 (0.7)	0.5 (0.5)	0.7 (0.6)
Health perception (VAS)	4.9 (1.3)	5.0 (1.0)	4.8 (1.2)	4.9 (1.6)

SOHI: Standard Oral Hygiene Instructions; P: Reading a pamphlet; V: Watching a video; BMI: Brief Motivational Interviewing; FMPS: Full-Mouth Plaque Score; FMBS: Full-Mouth Bleeding Score. VAS: Visual Analogue Scale
Standard deviations for quantitative variables and percentages for qualitative variables are reported in round brackets, while minimums and maximums are in square brackets

TABLE 2 RESULTS AT 30-MONTH FOLLOW-UP

Variable	Group SOHI n = 19	Group P n = 17	Group V n = 11	Group BMI n = 18
FMPS	41.9 (13.9)	44.6 (13.8)	35.3 (11.9)	41.6 (14.8)
FMBS	2.9 (3.4)	2.6 (2.3)	3.8 (4.6)	2.5 (2.6)
Tooth brushing (times per day)	1.9 (0.5)	2.3 (0.6)	2.3 (0.8)	2.7 (0.5)
Flossing (times per day)	0.8 (0.5)	0.9 (0.6)	0.8 (0.6)	1.0 (0.7)
Satisfaction score	8.8 (1.2)	8.8 (1.0)	8.7 (1.0)	8.7 (1.0)
Health perception (VAS)	6.0 (1.6)	6.6 (1.4)	6.3 (1.6)	6.8 (1.2)

SOHI: Standard Oral Hygiene Instructions; P: Reading a pamphlet; V: Watching a video; BMI: Brief Motivational Interviewing; FMPS: Full-Mouth Plaque Score; FMBS: Full-Mouth Bleeding Score. VAS: Visual Analogue Scale
Standard deviations are in round brackets

There was an improvement in the oral health perception for all groups, though the differences were not significant ($P = 0.3305$).
Twenty-five teeth had been lost in seventeen patients at 36-month follow-up. In the SOHI group, two patients had lost a total of 4 teeth (two teeth in one patient due to fracture and two teeth in the other patient due to periodontitis); in the P group, six patients had lost a total of 12 teeth (four teeth in one patient due to dysodontiasis, three teeth in one patient due to periodontitis, two teeth in one patient due to periodontitis, one tooth in two patients due to fracture, and one tooth in one patient due to caries); in the V group, two patients had lost one tooth each (one due to fracture and the other to periodontitis); while in the BMI group, seven

TABLE 3 RESULTS AT 36-MONTH FOLLOW-UP

Variable	Group SOHI n = 22	Group P n = 23	Group V n = 16	Group BMI n = 20	P-value
FMPS	46.1 [12.7]	47.7 [10.9]	41.5 [14.7]	37.2 [14.2]	0.0445*
Difference in FMPS between baseline and 24 months	19.7 [15.8]	20.0 [13.2]	23.7 [15.1]	29.9 [16.6]	0.0445*
FMBS	3.8 [3.6]	3.9 [3.7]	3.2 [2.7]	4.1 [4.4]	0.9716
Difference in FMBS between baseline and 24 months	2.1 [5.9]	3.2 [5.1]	2.3 [3.6]	3.6 [5.5]	0.9716
Tooth brushing (times per day)	2.0 [0.6]	2.3 [0.5]	2.4 [0.6]	2.5 [0.6]	0.0017**
Difference in tooth brushing frequency between baseline and 24 months	-0.1 [0.6]	0.2 [0.6]	-0.1 [0.4]	0.5 [0.5]	0.0017**
Flossing (times per day)	0.8 [0.6]	0.8 [0.6]	0.7 [0.4]	1.0 [0.7]	0.1991
Difference in flossing frequency between baseline and 24 months	0.0 [0.6]	0.1 [0.6]	0.1 [0.5]	0.3 [0.4]	0.1991
Satisfaction score	8.9 [1.2]	9.2 [1.0]	8.7 [0.9]	8.4 [0.9]	0.1605
Health perception (VAS)	5.8 [1.6]	6.4 [1.3]	5.9 [1.1]	6.5 [1.3]	0.3305
Difference in health perception between baseline and 24 months	0.8 [1.3]	1.3 [1.5]	1.1 [1.5]	1.3 [1.9]	0.3305
Teeth lost	0.2 [0.6]	0.5 [1.1]	0.1 [0.3]	0.3 [0.5]	0.2847
Total intervention time (minutes)	52.9 [7.6]	51.2 [14.7]	45.7 [9.9]	81.6 [15.1]	<0.0001***

SOHI: Standard Oral Hygiene Instructions; P: Reading a pamphlet; V: Watching a video; BMI: Brief Motivational Interviewing; FMPS: Full-Mouth Plaque Score; FMBS: Full-Mouth Bleeding Score.

VAS: Visual Analogue Scale

Standard deviations are in round brackets

*Statistically significant BMI values compared to P ($P = 0.0445$)

**Statistically significant BMI values compared to SOHI ($P = 0.0017$)

***Statistically significant BMI values compared to all other methods ($P < 0.0001$)

patients lost one tooth each (four due to periodontitis, two due to fracture, and one due to caries). The difference between groups was not significant ($P = 0.2847$)

As for the total time spent for the motivation sessions, the BMI took the longest, with a statistically significant difference as compared to the other techniques (difference between BMI and SOHI was 28.7 minutes [95%CI from 18.7 to 38.7]; difference between BMI and P was 30.5 minutes [95%CI from 20.6 to 40.4]; difference between BMI and V was 36.0 minutes [95%CI from 25.1 to 46.9], $P < 0.0001$).

DISCUSSION

The aim of this study was to compare four methods of motivation and oral hygiene instruction with a 3-year follow-up. The present investigation revealed that the four different motivation methods, i.e., standard oral hygiene instructions, pamphlets, educational videos, and Brief Motivational Interviewing are all effective. All tested methods were appreciated by enrolled subjects, and improved the values of FMPS and FMBS up to three years of follow-up.

In the two previous follow-ups of the same study, no statistically significant differences were observed between the four methods of motivation for FMPS, FMBS, mean number of teeth lost, degree of patient satisfaction or perception of oral health at 1 and 2 years^{48,49}.

However, a difference in FMPS was evidenced in this three-year follow-up study. In particular, the BMI group achieved a greater reduction in bacterial plaque than the P group. The difference, of about 10 percentage points in FMPS, was equal to that which we had indicated in the a priori calculation of the sample size as the minimum difference that could have a certain weight from a clinical point of view. Nevertheless, this difference in FMPS reduction did not result in a corresponding difference between the groups in FMBS reduction, which was very similar in the four groups compared. Also, the mean number of teeth lost, the degree of patient satisfaction, and the perception of oral health were very similar in the four groups tested.

Another RCT evaluated whether inclusion of a single motivational interviewing session administered by a psychologist, as an adjunct to periodontal therapy, might be beneficial for preventing relapse in oral hygiene behaviours among patients treated for chronic periodontitis⁴⁰. Marginal bleeding index and plaque index were assessed at 6-month and 3-year follow-ups^{40,53}, with no differences being observed between the two groups. The authors therefore concluded that a single BMI session does not add beneficial effects to standard periodontal therapy by improving oral hygiene behaviour⁴⁰. The results of our study are comparable to the above⁴⁰, considering that the significant difference in FMPS we found was between BMI and P, not between BMI and SOHI.

In the previous follow-ups, BMI induced a statistically significantly greater increase in the frequency of daily brushing with respect to SOHI and V at 1 and 2 years^{48,49}. This trend was maintained at 3-year follow-up. This is in line with reports in the literature that psychological interventions like BMI can produce significant improvements in oral health behaviours, and in self-efficacy regarding tooth brushing³⁹. The clinical significance of these differences is, however, difficult to estimate, and long-term effects have not been investigated elsewhere³⁹. This trial plans to test the methods of oral hygiene motivation until 10 years of follow-up, in order to assess, participants' long-term adherence and quality of oral health. Meanwhile, no differences between receiving standard oral hygiene instructions, reading a pamphlet, and watching a video were observed over three years. All three methods seemed to be equally effective in improving home oral hygiene manoeuvres in adult subjects. However, this randomized clinical trial indicates that the BMI technique is more effective than P in reducing the percentage of FMPS. However, this may not have important clinical implications, and it should also be considered that the BMI technique is more complex and requires more time than the other methods.

CONCLUSIONS

All tested methods improved FMPS and FMBS and were appreciated by all enrolled subjects. The reduction in FMPS was greater with BMI with respect to P. Indeed, the change in patient behaviour was more pronounced with BMI, significantly improving the frequency of daily tooth brushing with respect to SOHI. However, the intervention time required was greater than for the other techniques, although compatible with a professional oral hygiene session of one hour duration.

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