

EFFICACY OF FOUR MOTIVATIONAL TECHNIQUES FOR IMPROVING ORAL HYGIENE. ONE-YEAR FOLLOW-UP OF A RANDOMISED CONTROLLED TRIAL



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PURPOSE. The aim of this randomised controlled trial with blinded examiner was to compare the efficacy of four different methods of enhancing oral hygiene motivation in: 1) modifying patient behaviour, 2) reducing the full-mouth plaque score (FMPS) and full-mouth bleeding score (FMBS), 3) amount of the intervention time required, 4) the degree of patient satisfaction at one-year follow-up.

MATERIALS AND METHODS. In a private practice, 100 subjects aged 18–75 years with at least 20 teeth/implants present and a FMPS $\geq 40\%$ were consecutively recruited. From baseline up to one-year of follow-up, the subjects randomly underwent one of four different oral hygiene motivational techniques, namely (i) standard instructions on oral hygiene (SIOH); ii) reading a pamphlet (P); iii) watching a video (V); or iv) Brief Motivational interviewing (BMI). 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 for each method. A sole operator carried out all motivational sessions and/or professional oral hygiene procedures at baseline and at 1, 3, 6 and 12 months. Another operator, blinded to the methods used, recorded the variables at baseline, and at 6 and 12 months.

RESULTS. At 12-month follow-up, there were no significant differences between the four tested methods in either FMPS [−16.7 for SIOH, −18.8 for V, −20.1 for P, and −27.7 for BMI; $P = 0.0730$], FMBS [−3.0 for SIOH, −2.3 for V, −4.2 for P, and −2.9 for BMI; $P = 0.5776$], degree of patient satisfaction ($P = 0.2410$), improvement in perception of oral health ($P = 0.2067$), frequency of daily flossing ($P = 0.2500$), or number of teeth lost ($P = 0.5296$). Although the total time required for motivation was significantly greater for the BMI than the other techniques ($P < 0.0001$), the frequency of daily tooth brushing significantly increased after BMI as compared to SIOH and V [the difference between BMI and SIOH was 0.6; 95%CI from 0.2 to 1.0, and the difference between BMI and V was 0.5 95%CI from 0.1 to 0.9; $P = 0.0011$].

CONCLUSIONS. All tested methods improved FMPS and FMBS, and were appreciated by all subjects. The change in patient behaviour was more pronounced in the BMI group, but the intervention time required was greater than in the other techniques; nevertheless it was compatible with a professional oral hygiene session of one-hour duration.

CONFLICTS OF INTEREST STATEMENT. The authors declare that they have completely self-funded the study, and that there are no conflicts of interest.

INTRODUCTION

Periodontal disease can be slowed or stabilised by reducing bacterial biofilm deposition. Professional periodontal therapy is crucial for control of this disease, but the quality of oral hygiene at home and patient compliance with an individualised periodontal care programme is fundamental in the long-term prevention and treatment of periodontal disease¹⁻⁸. However, some studies^{9,10} on the effectiveness of oral hygiene motivation have shown that patient adherence to a programme of home and professional periodontal maintenance remains generally poor. Often, periodontal treatment support sessions are cancelled, resulting in reduced periodontal health, decreased motivation and attention to oral hygiene at home, and the possibility of recurrence of periodontal disease¹⁰⁻¹².

The observation that patient compliance tends to decrease over time has led to the hypothesis that the traditional methods of motivation to oral hygiene at home might not be effective in all subjects. This consideration was the stimulus for research to identify and test many new tools and various methods of more patient-centred motivation for behavioural change¹³. For example, new technologies have facilitated the spread of affordable DVDs and videos accessible online on diseases of the oral cavity and oral hygiene techniques. The internet also provides webpages where issues related to oral diseases and their prevention and treatment are discussed. However, there is little evidence in the dentistry and periodontal health literature on the effectiveness of these new tools in increasing the motivation and quality of oral hygiene techniques practiced at home¹⁴.

Patient-centred counseling techniques^{15,16} can be used as a replacement for traditional methods of motivation to induce behavioural change. In fact, the results of one study showed that an individually tailored oral health education programme, based on a behavioural-medicine approach, was preferable to a standard education programme as an intervention for improving oral hygiene behaviours in patients with periodontal issues¹⁷. Advancements in cognitive psychology also enable healthcare providers to motivate patients to be more responsible for managing their own health through behavioural change¹⁸⁻²⁴. Changing health behaviours through motivation is the focus of Motivational Interviewing (MI). Motivational interviewing (MI)^{21,25} is a "collaborative, person-centred form of guiding to elicit and strengthen motivation for change". This directive method enhances intrinsic motivation by exploring and resolving a person's ambivalence about change^{23,24}. MI has been shown to be effective for achieving behaviour change related to obesity, drug rehabilitation, physical fitness, mental health, glycaemic control (in diabetics), smoking cessation, treatment for alcoholism, HIV/AIDS, drug abuse, medication adherence, gambling and eating disorders^{21,23,24,26-30}.

That being said, there is currently insufficient and controversial information on the use of MI in dentistry and periodontal health support³¹⁻³⁴, and a specific method of using MI needs to be developed for oral health professionals^{35,36}. The Brief Motivational Interviewing (BMI)^{21,25} can be used in the field of prevention and health education and, more generally, in all those situations where it is desirable or necessary to promote adherence to treatment regimes, reduce risk behaviours and promote healthy habits. Due to the small number of sessions and the specific tools provided, dentistry practitioners too may be able to use the BMI^{21,25} without incurring additional costs and without the intervention of a psychologist.

We set out to test the efficacy of this instrument, in comparison to three other methods of patient motivation, on oral hygiene in a randomised controlled trial with blinded examiner and one-year follow-up. Outcome measures were: the full mouth plaque score (FMPS), the full mouth bleeding score (FMBS), patient behaviour (frequency of daily tooth brushing), the intervention time required for each technique, and the degree of patient satisfaction with each method.

MATERIALS AND METHODS

Trial design

This single-centre, parallel randomised controlled trial had 4 arms, with an allocation ratio of 1:1:1:1 to the four motivational technique groups, and a blinded examiner. It was conducted according to the recommendations of the CONSORT Statement for the quality of randomised controlled trials³⁷.

Eligibility criteria for participants

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

Inclusion criteria were:

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

The exclusion criteria were:

- Subjects with disabilities that could compromise their understanding of the motivational technique tested;
- Patients receiving chemotherapy for cancer;
- Women with ongoing pregnancy at baseline;
- Subjects suffering from diseases that could affect the frequency of their attendance.

Setting and location

The subjects were consecutively recruited from patients attending a private dental practice in Campi Bisenzio, Italy, from 5th September to 2nd December 2011. The investigators explained the nature of the trial and its aims and methods to the patients fully, anticipating the benefits, potential risks, and any form of discomfort that participation might entail. The patients read and asked questions inherent to the study prior to signing their informed consent.

Interventions

The four methods of oral hygiene motivation tested were the following.

Standard instruction on oral hygiene (SIOH): chairside instruction on toothbrushing and interproximal cleaning techniques.

Pamphlet (P): home reading of a 20-page printed pamphlet (text and images) with the same content as the abovementioned video.

Video (V): home viewing of a 20-minute video. A DVD containing the educational video was given to the patients. The video illustrated the risks of undisturbed accumulation of plaque in the oral cavity, and the proper techniques for both tooth brushing (roll technique) and the use of dental floss and/or toothpicks.

Brief Motivational Interviewing (BMI): this method was based on both the *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 the *primary activities* (i.e. open questions, active listening, clarifying and summarizing, and negotiating goals and strategies) of motivational interviewing (MI). The BMI consisted of administering *primary activities* by *appropriate tools* [a] questionnaire on “importance” and “trust”; b) diary of the objectives, strategies to achieve them and goals; and c) home oral hygiene diary]^{22,25}.

At baseline, a single operator, a dental hygienist with over 10 years of experience (MG), assessed whether participants met the inclusion criteria. The same dental hygienist carried out all motivational sessions and professional oral hygiene procedures required at baseline and at the scheduled recalls (one, two, three, six and twelve months). Patients were all given (by MG) a questionnaire to be filled out at baseline, and were randomised to one of the four groups: 1 (SIOH), 2 (P), 3 (V), 4 (BMI), contained within a sealed envelope. At each session, the time required to perform the randomly allocated motivational procedure was recorded with a chronometer. Patients were re-assessed at 1, 3, 6, and 12 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 SIOH 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 according to individual need at months 6 and 12.

Outcome measures

An assessor blinded to the treatment selected (UP) recorded all outcome measures. The examiner conducted a plaque test for calibration purposes, and was then subjected to an intra-rater agreement test, which resulted in a kappa score of 0.85, considered almost perfect agreement³⁸.

At the scheduled 6- and 12-month appointments, the examiner (UP), blinded to the motivation technique administered, recorded the following clinical variables.

- Plaque accumulation at six sites per tooth/implant³⁹ evaluated as Full-Mouth Plaque Score (FMPS). The examiner used a 3.2x magnification system and a staining liquid to detect the presence or absence of plaque at each site assessed.
- Bleeding on probing at six sites per tooth/implant⁴⁰ evaluated as Full-Mouth Bleeding Score (FMBS); the examiner used a 3.2x magnification system to detect the presence or absence of bleeding at each site assessed.
- Frequency of daily tooth brushing, as reported in the questionnaire.
- Frequency of daily flossing, as reported in the questionnaire.
- Patient satisfaction score (assessed using a score of 0 to 10) for the given technique, as reported in the questionnaire.
- Patient perception of their own oral health level (assessed on a VAS from 0 to 10), as reported in the questionnaire.
- Number of teeth lost.

Sample size

Considering $\alpha = 0.05$, a power of 80%, a standard deviation of 10 in FMPS¹⁷ 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.

Randomisation and blinding

A computer-generated list of random numbers was used for participant allocation. A blocked randomisation was applied to allocate 25 patients to each of the four treatment groups. 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 envelope. 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, while analysis of covariance (ANCOVA) was performed for the outcome variables: change in FMPS, change in FMBS, change in daily flossing frequency, change in daily brushing frequency, and change in perceived periodontal 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 a 95% confidence interval of the differences between treatments. Intention-to-treat analysis was performed, and the statistical software used was JMP v. 13 (SAS Institute, Cary, NC).

RESULTS

One hundred patients were consecutively enrolled in the trial and randomly allocated to the four experimental groups. As a consequence, 25 patients per group underwent the four different motivational approaches: standard instructions on oral hygiene (SIOH), pamphlet (P), video (V), and Brief Motivational Interviewing (BMI). Patients were recruited and treated at a private practice from September to December 2011. The final (12-month) follow-up was performed in December 2012.

Baseline patient characteristics are shown in **TABLE 1**. There were no apparent imbalances between the four groups at baseline, except that more females were allocated to the BMI group.

TABLE 1 CHARACTERISTICS OF THE FOUR GROUPS AT BASELINE

Variable	SIOH group n = 25	P group n = 25	V group n = 25	BMI group 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)

Legend SIOH: Standard instructions on oral hygiene; 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 in round brackets, while minimums and maximums are in square brackets.

One patient belonging to the SIOH group dropped out at six months and declined to return for the follow-up visits. One patient belonging to the P group dropped out at one month, declining to return for follow-up visits. Seven patients belonging to the V group dropped out (two at 1-month follow-up, four at 3-month follow-up and one at 6 months) and declined to return for follow-up visits. Two patients belonging to the BMI group dropped out at 1 and 6 months, respectively, and declined to return for follow-up visits.

There were no deviations from the protocol.

Results recorded at 6 and 12 months are shown in **TABLES 2** and **3**, respectively. As very similar responses were found at 6 and 12 months, only the latter data will be considered. Of note, at 12-month follow-up the improvement from baseline in terms of FMPS was substantial [16.7 for SIOH, 20.1 for P, 18.8 for V, and 22.7 for BMI], and the within-group changes from baseline were significant ($P < 0.0001$ for all groups). However, no statistically significant differences in FMPS were detected between the four tested methods ($P = 0.0730$).

In terms of FMBS, the changes were more moderate (3.0 for SIOH, 4.2 for P, 2.3 for V, and 2.9 for BMI), with no significant differences between the four methods ($P = 0.5776$). The within-group changes from baseline were significant for SIOH, P, and V ($P < 0.05$) and not significant for BMI ($P = 0.07$).

The change in daily tooth brushing frequency was null for SIOH and V, while the BMI group showed an increase of 0.6. The frequency of daily tooth brushing increased significantly in the BMI group, as compared to SIOH and V (the difference between BMI and SIOH was 0.6; 95%CI from 0.2 to 1.0, and the difference between BMI and V was 0.5 95%CI from 0.1 to 0.9; $P = 0.0011$). The improvement in daily flossing frequency was also null or very low in all four groups, and the difference was not statistically significant ($P = 0.2500$).

The patient satisfaction score (assessed on a scale of 0 to 10) for the given technique was high in all groups, and the differences between them were not significant ($P = 0.2410$). All groups reported an improvement in oral health perception, but the differences were not significant ($P = 0.2067$).

Eight teeth had been lost in six patients at 12-month follow-up. In the SIOH group two patients had lost one tooth each (one due to fracture and the other to periodontitis); in the P group two patients had lost two teeth each (two teeth in one patient due to periodontitis and two teeth in one patient to dysodontiasis); in the BMI group, two patients lost one tooth each (one due to fracture and the other to periodontitis). The difference between groups was not significant ($P = 0.5296$).

As for the total time spent on motivation, BMI took significantly longer than the other techniques (difference between BMI and SIOH was 24.2 minutes [95%CI from 18.2 to 30.2]; difference between BMI and P was 26.3 minutes [95%CI from 20.3 to 32.4]; difference between BMI and V was 30.3 minutes [95%CI from 23.8 to 36.8], $P < 0.0001$).

DISCUSSION

This investigation reveals that the four different methods of motivating oral hygiene examined, consisting, respectively, of standard instructions, pamphlets, educational video, and Brief Motivational Interviewing (BMI), are all effective. All tested methods were appreciated by enrolled subjects, and all improved FMPS and FMBS up to 1 year of follow-up.

No statistically significant differences were observed between the four methods of motivation in terms of FMPS, FMBS, frequency of daily flossing, mean number of teeth lost, degree of patient satisfaction or perception of oral health. However, BMI induced a statistically significantly greater increase in the frequency of daily brushing with respect to standard instructions and video motivation ($P = 0.0011$). Although the BMI motivation required a significantly greater total

TABLE 2 RESULTS AT 6-MONTH FOLLOW-UP

Variable	SIOH group n = 24	P group n = 24	V group n = 18	BMI group n = 23	P-value
FMPS	53.4 (13.7)	52.6 (15.1)	48.6 (16.7)	45.9 (15.4)	0.2220
Difference in FMPS between baseline and 6 months	12.6 (16.1)	14.7 (16.2)	15.7 (16.4)	22.1 (14.4)	0.2220
FMBS	3.9 (2.7)	4.1 (2.8)	4.2 (3.6)	3.8 (3.6)	0.7276
Difference in FMBS between baseline and 6 months	1.8 (3.9)	3.4 (4.4)	1.1 (5.2)	3.5 (3.7)	0.7276
Tooth brushing (times per day)	2.1 (0.5)	2.2 (0.5)	2.4 (0.7)	2.6 (0.5)	0.0021*
Difference in tooth brushing between baseline and 6 months	0.0 (0.4)	0.2 (0.6)	-0.1 (0.7)	0.6 (0.5)	0.0021*
Flossing (times per day)	0.8 (0.5)	0.8 (0.6)	0.7 (0.4)	1.0 (0.7)	0.3002
Difference in flossing between baseline and 6 months	-0.0 (0.5)	0.2 (0.7)	0.1 (0.4)	0.2 (0.4)	0.3002
Satisfaction score	8.6 (1.3)	8.7 (1.0)	8.5 (0.9)	8.2 (1.1)	0.4020
Health perception (VAS)	5.8 (1.3)	5.8 (1.2)	5.7 (1.3)	6.3 (1.3)	0.4156
Difference in health perception between baseline and 6 months	0.9 (1.0)	0.8 (1.2)	1.0 (1.6)	1.3 (1.7)	0.4156

Legend SIOH: Standard instructions on oral hygiene; 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 SIOH and V ($P = 0.0021$).

TABLE 3 RESULTS AT 12-MONTH FOLLOW-UP

Variable	SIOH group n = 24	P group n = 24	V group n = 18	BMI group n = 23	P-value
FMPS	49.2 (12.5)	47.2 (12.1)	45.4 (13.3)	40.3 (14.9)	0.0730
Difference between baseline and 12 months in FMPS	16.7 (14.1)	20.1 (13.2)	18.8 (14.9)	27.7 (15.9)	0.0730
FMBS	2.8 (3.0)	3.3 (3.7)	2.9 (3.1)	4.4 (5.0)	0.5776
Difference between baseline and 12 months in FMBS	3.0 (5.2)	4.2 (5.2)	2.3 (3.8)	2.9 (7.3)	0.5776
Tooth brushing (times per day)	2.0 (0.5)	2.3 (0.6)	2.3 (0.7)	2.5 (0.6)	0.0011*
Difference in tooth brushing between baseline and 12 months	-0.1 (0.5)	0.2 (0.6)	-0.2 (0.6)	0.5 (0.5)	0.0011*
Flossing (times per day)	0.7 (0.5)	0.9 (0.6)	0.7 (0.4)	0.9 (0.6)	0.2500
Difference in flossing between baseline and 12 months	-0.0 (0.5)	0.2 (0.7)	0.1 (0.4)	0.2 (0.4)	0.2500
Satisfaction score	8.6 (1.2)	8.8 (1.0)	8.7 (1.0)	8.1 (1.7)	0.2410
Health perception (VAS)	5.6 (0.9)	6.0 (1.3)	5.7 (1.5)	6.4 (1.3)	0.2067
Difference in health perception between baseline and 12 months	0.7 (1.1)	0.9 (1.4)	1.0 (1.9)	1.3 (1.8)	0.2067
Tooth loss	0.1 (0.3)	0.2 (0.6)	0.0 (0.0)	0.1 (0.3)	0.5296
Total time (minutes)	35.2 (6.6)	33.0 (7.8)	29.1 (6.8)	59.3 (9.7)	<0.0001**

Legend SIOH: Standard instructions of oral hygiene; P: Reading of a pamphlet; V: Overview of 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 SIOH and V ($P = 0.0011$).

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

time than all other tested methods ($P < 0.0001$), this time was compatible with the operational requirements of a professional oral hygiene session of one hour duration.

Our results reflect the improvements reported by a meta-analysis on the effects of motivational interviewing *versus* education and/or information on *gingivitis* (bleeding on probing: -2.81 [95% CI: $-11.54, 5.91$]), differences which were, however, neither statistically nor clinically significant³³. Like our results, significant improvements in oral health behaviours, and in self-efficacy regarding tooth brushing, were reported in favour of psychological interventions³³, even though the clinical relevance of these differences was difficult to estimate, and long-term effects were not investigated³³.

In our study, the improvement from the baseline over the course of a year in terms of FMPS was substantial, but there were no statistically significant differences between the four tested methods. Nevertheless, the within-group changes from baseline were significant for all groups. The Hawthorne effect could have played a role in this improvement; this is a type of reactivity in which individuals modify an aspect of their behaviour in response to their awareness of being observed⁴¹. In this context, it is possible that the patients improved their oral hygiene because they knew that they were being monitored⁴². Indeed, as a real control group, without any treatment, was not part of our study, it is difficult to ascribe the improvement to the various interventions. That being said, what really matters in an RCT is the difference between the techniques, rather than the difference within each group.

Another RCT evaluated whether inclusion of a single session of motivational interviewing, as an adjunct to periodontal therapy, might be beneficial for preventing relapse in oral hygiene behaviours among patients treated for chronic periodontitis³⁴. Marginal bleeding index and plaque index were assessed at 6-month and 3-year follow-ups^{34,43}, with no differences being observed between the two groups; the conclusion of the authors was therefore that a single BMI session does not add beneficial effects to standard periodontal therapy for efficacious oral hygiene behaviour³⁴. We repeated the BMI (and the other motivational techniques) at each session (baseline, 1-, 3-, 6-, and 12-month recall visits), with similar FMBS results. However, as already reported, and in agreement with the conclusions of a systematic review³³, in our study BMI did induce a significantly greater increase in the frequency of daily brushing vs. SIOH (or V). Furthermore, it should be noted that in our study a dental hygienist operator conducted the BMI, which enabled us to repeat the BMI (and the other motivational techniques) at each recall session with reduced costs.

Recently, a clustered randomised controlled trial at two public primary schools was performed¹⁴. About 220 schoolchildren aged 10–11 years were included in that study and grouped into two clusters. Children in Leaflet cluster received oral health education through leaflets, while children in E-learning cluster received oral health education through an E-learning programme¹⁴. The E-learning programme was full of colourful images, videos, interactive quizzes and age-related developmental tasks in the quest to deliver the information in an interactive, entertaining and simple manner. The E-learning programme included the same information as the leaflet, and only the way in which the content was conveyed to the children was different¹⁴. Interestingly, children in Leaflet cluster had significantly less plaque and statistically significantly better gum health than the E-learning cluster at 6 weeks ($P < 0.05$) and 12 weeks ($P < 0.05$)¹⁴. In our study on adult subjects, however, differences between standard instructions, reading a pamphlet, and watching a video on oral hygiene were not observed after one year of follow-up. All three methods seemed to be equally effective in improving home oral hygiene in adult subjects. BMI, on the other hand, proved able to induce changes in behaviour and lifestyle, i.e., an increased frequency of daily tooth brushing, even though it was as effective as the other techniques in reducing FMPS and FMBS percentages.

In this study, we also recorded the number of teeth lost by each patient. The difference between groups was not significant. However, the sample size was not calculated with this variable in mind, and so the study could be underpowered in this respect. Nevertheless, this variable is of the utmost importance from a clinical standpoint, and will be tested in subsequent updates of this study; an important limitation of this study is the short duration of follow-up, but we plan to prolong the follow-up until at least 3 years in order to assess the patients' long-term adherence and quality of oral health.

As the interventions were designed for adults with high levels of dental plaque, our results cannot be extrapolated to children or adolescents, or to patients with low level of dental plaque, who are already sufficiently motivated to preserve their oral health.

CONCLUSIONS

All tested methods improved FMPS and FMBS and were appreciated by enrolled subjects. Nonetheless, BMI was able to change patient behaviour, significantly improving the frequency of daily tooth brushing with respect to SIOH and V, without, however, leading to a significantly greater difference in FMPS and FMBS than other oral hygiene methods over the course of a year. The time required for BMI was greater than the other methods, but still compatible with a 1-hour professional oral hygiene session.

REFERENCES

1. Hirschfeld I. The toothbrush: Its use and abuse. New York: Dental Items of Interest Publishing Co., 1939.
2. Goldman MJ, Ross IF, Goteiner D. Effect of periodontal therapy on patients maintained for 15 years or longer. A retrospective study. *J Periodontol* 1986;57:347-53.
3. Cobb CM. Non-surgical pocket therapy: mechanical. *Ann Periodontol* 1996;1:443-90.
4. Pihlstrom BL, Ammons WF. Treatment of gingivitis and periodontitis. Research, Science and Therapy Committee of the American Academy of Periodontology. *J Periodontol* 1997;68:1246-53.
5. Albandar JM. Global risk factors and risk indicators for periodontal diseases. *Periodontology* 2000 2002;29:177-206.
6. Leung WK, Ng DK, Jin L, Corbet EF. Tooth loss in treated periodontitis patients responsible for their supportive care arrangements. *J Clin Periodontol* 2006;4:265-75.
7. Ramseier CA, Catley D, Krigel S, Bargramian RA. Motivational Interviewing. In: Lang NP, Lindhe J. (eds). *Clinical Periodontology and Implant Dentistry*. 5th edition. Oxford: Blackwell Munksgaard, 2008:695-702.
8. Nieri M, Giani M, Pagliaro U, Picciullo A, Franceschi D, Rotundo R. Efficacy and preference of manual toothbrushes: a randomised, single blind, controlled trial. *Eur J Oral Implantol* 2013;6:181-8.
9. Johansson LA, Oster B, Hamp SE. Evaluation of cause-related periodontal therapy and compliance with maintenance care recommendations. *J Clin Periodontol* 1984;11:689-99.
10. Schüz B, Sniehotta FF, Wiedemann A, Seemann R. Adherence to a daily flossing regimen in university students: effects of planning when, where, how and what to do in the face of barriers. *J Clin Periodontol* 2006;33:612-9.
11. Wilson TG Jr, Glover ME, Schoen J, Baus C, Jacobs T. Compliance with maintenance therapy in a private periodontal practice. *J Periodontol* 1984;55:468-73.
12. Demetriou N, Tsami-Pandi A, Parashis A. Compliance with supportive periodontal treatment in private periodontal practice. A 14-year retrospective study. *J Periodontol* 1995;66:145-9.
13. Schlueter N, Klimek J, Ganss C. Relationship between plaque score and video-monitored brushing performance after repeated instruction - A controlled, randomised clinical trial. *Clin Oral Investig* 2013;17:659-67.
14. Al Bardaweel S, Dashash M. E-learning or educational leaflet: does it make a difference in oral health promotion? A clustered randomized trial. *BMC Oral Health* 2018;18:81.
15. Renz AN, Newton JT. Changing the behavior of patients with periodontitis. *Periodontol* 2000 2009;51:252-68.
16. Renz A, Ide M, Newton T, Robinson PG, Smith D. Psychological interventions to improve adherence to oral hygiene instructions in adults with periodontal diseases. *Cochrane Database Syst Rev* 2007 Apr 18;(2):CD005097.
17. Jönsson B, Ohn K, Oscarson N, Lindberg P. 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;36:1025-34.
18. Evans RI. The social psychology of persuasion: the use of fear and other problems. *J Am Soc Prev Dent* 1972;2:18-21.
19. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, so-

- cial development and well-being. *Am Psychol* 2000;55:68-78.
20. Schou L. The relevance of behavioural sciences in dental practice. *Int Dent J* 2000;50:324-32.
21. Miller WR, Rollnick S. *Motivational interviewing: preparing people to change*. New York, NY, USA: Guilford Press, 2002.
22. Nield-Gehrig JS, Willmann DE. *Helping patients change behavior: periodontics for the dental hygienist*. Baltimore, MD, USA: Lippincott, 2008.
23. Rollnick S, Miller WR, Butler C. *Motivational interviewing in health care. Helping patients change behavior*. New York, NY, USA: Guilford Press, 2008.
24. Miller WR, Rollnick S. Ten things that motivational interviewing is not. *Behav Cogn Psychother* 2009;37:129-40.
25. Rollnick S, Mason P, Butler C. *Health behavior change*. London: Harcourt Brace and Company Limited, 1999.
26. Rollnick S, Butler CC, Stott N. Helping smokers make decisions: the enhancement of brief intervention for general medical practice. *Patient Educ Couns* 1997;31:191-203.
27. Amrhein PC, Miller WR, Yahne CE, Palmer M, Fulcher L. Client commitment language during motivation interviewing predicts drug use outcomes. *J Consult Clin Psychol* 2003;71:862-78.
28. Butterworth S, Linden A, McClay W, Leo MC. Effect of motivational interviewing-based health coaching on employees' physical and mental health status. *J Occup Health Psychol* 2006;1:358-65.
29. Carels RA, Darby L, Cacciapaglia HM et al. Using motivational interviewing as a supplement to obesity treatment: a stepped-care approach. *Health Psychol* 2007;26:369-74.
30. Channon SJ, Huws-Thomas MV, Rollnick S et al. A multicenter randomized controlled trial of motivational interviewing in teenagers with diabetes. *Diabetes Care* 2007;30:1390-5.
31. López-Jornet P, Fabio CA, Consuelo RA, Paz AM. Effectiveness of a motivational-behavioural skills protocol for oral hygiene among patients with hyposalivation. *Gerodontology* 2014;31:288-95.
32. Kay EJ, Vascott D, Hocking A, Nield H. Motivational interviewing in general dental practice: a review of the evidence. *Br Dent J* 2016;221:785-91.
33. Werner H, Hakeberg M, Dahlström L, Eriksson M, Sjögren P, Strandell A, Svanberg T, Svensson L, Wide Boman U. Psychological interventions for poor oral health: a systematic review. *J Dent Res* 2016;95:506-14.
34. Stenman J, Wennström JL, Abrahamsson KH. A brief motivational interviewing as an adjunct to periodontal therapy - A potential tool to reduce relapse in oral hygiene behaviours. A three-year study. *Int J Dent Hyg* 2018;16:298-304.
35. Yevlakhova D, Satur J. Models for individual oral health promotion and their effectiveness: a systematic review. *Aust Dent J* 2009;54:190-7.
36. Gao X, Lo EC, Kot SC, Chan KC. Motivational interviewing in improving oral health: a systematic review of randomized controlled trials. *J Periodontol* 2014;85:426-37.
37. Moher D, Hopewell S, Schulz KF, Montori V, Gøtzsche PC, Devereaux PJ, Elbourne D, Egger M, Altman DG. CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *Br Med J* 2010;23:340:c869.
38. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977;33:159-74.
39. O'Leary T. The periodontal screening examination. *J Periodontol* 1967;38:617-24.
40. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. *Int Dent J* 1975;25:229-35.
41. McCambridge J, Witton J, Elbourne DR. Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. *J Clin Epidemiol* 2014;67:267-77.
42. Feil PH, Grauer JS, Gadbury-Amyot CC, Kula K, McCunniff MD. Intentional use of the Hawthorne effect to improve oral hygiene compliance in orthodontic patients. *J Dent Educ* 2002;66:1129-35.
43. Stenman J, Lundgren J, Wennström JL, Ericsson JS, Abrahamsson KH. A single session of motivational interviewing as an additive means to improve adherence in periodontal infection control: a randomized controlled trial. *J Clin Periodontol* 2012;39:947-54.