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Effectiveness of motivational interviewing to improve oral hygiene in orthodontic patients: A randomized controlled trial

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Abstract

Maintaining good oral hygiene in patients wearing fixed appliances is a challenge for orthodontics. Conventional education has been demonstrated to be insufficient for the promotion of good oral habits, while motivational interviewing has the potential to facilitate health behavior change. The present randomized controlled trial with 130 patients aimed to evaluate the effectiveness of a single session of motivational interviewing in enhancing oral hygiene in orthodontic patients compared with conventional education alone. Results revealed an immediate improvement in oral hygiene which remained stable throughout the 6-month follow-up.

Keywords

adolescence, health behavior, health education, randomized controlled trial, stages of change

Introduction

Maintaining good oral hygiene is a challenge among patients undergoing fixed appliance orthodontic treatment (Acharaya et al., 2011).

Biofilm formation in orthodontic patients that do not maintain good oral hygiene can have serious consequences such as enamel demineralization, gingival inflammation, and caries. These conditions can affect 50–70 percent of patients with fixed appliances and can have a significant impact on patients' oral health and quality of life (Arnold et al., 2016).

Conventional education, which focuses on giving normative advice, is insufficient to achieve sustained behavioral changes. However, motivational interviewing (MI) has been found to be effective in changing a broad range of behaviors related to lifestyle and it has recently been introduced into

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changing oral health behaviors (Croffoot et al., 2010; Ismail et al., 2011; Lalic et al., 2012).

MI is a collaborative, person-centered form of guiding conversation undertaken by health professionals to elicit and strengthen patients' motivation to change. It is internationally recognized as an effective intervention for supporting people to make positive changes in the management of their lifestyle behaviors (Martins et al., 2009; Mitchell et al., 2014; Neff et al., 2013). The main aim of MI is facilitating behavior change by helping patients to explore and resolve their ambivalence about the behavior change. Fixed appliances used for orthodontic treatment, which usually lasts an average of 24 months, increase plaque formation and make oral hygiene more difficult. Moreover, these are usually performed in adolescent patients who have suboptimal manual ability and low motivation regarding oral hygiene maintenance. This could be useful to change oral hygiene habits in orthodontic patients, who often develop gingival disorders, especially those patients with poor long-term compliance with regard to preventive recommendations (Gao et al., 2013; Miller and Rollnick, 2009; Moyers et al., 2005).

MI is used to facilitate a person's movement toward a desired health change behavior, via engaging with the patient, focusing work on a particular objective, evoking the person's motivation for change, and developing a change plan. The transtheoretical model of change of Prochaska and Diclemente (1984) provides a framework for categorizing a person's readiness to change his or her behavior and includes five stages: precontemplation, contemplation, preparation, action, and maintenance. Each stage of change represents both a period of time and several tasks needed for movement to the next stage (Armitage and Arden, 2007).

Initial studies in the field of periodontology with regard to MI showed controversial results (Gao et al., 2014). In fact, other studies found no beneficial effects on periodontal therapy after a single session of MI (Brand et al., 2013; Harrison, 2014). As a consequence, there is no enough evidence yet to improve habits in orthodontic population (Curtin et al., 2014; Freudenthal and Bowen, 2010).

We sought to evaluate the effectiveness of a single session of MI with conventional education compared with conventional education alone in enhancing oral hygiene. To that end, the decreasing value of plaque and gingival indexes, in adolescents and young adults wearing fixed appliances, was measured.

Our hypothesis was that a single session of MI would result in improved oral hygiene, which was measured by a decreasing value of plaque and gingival indexes, and would remain stable at a 6-month follow-up.

Material and methods

Study design and ethical approval

A randomized controlled trial has been conducted at the Department of Orthodontics of Hospital Odontològic Universitat de Barcelona.

The protocol of this study was reviewed and approved by the Research Ethics Committee of the Hospital Odontològic Universitat de Barcelona in July 2015 (Approval No. 2015-07) and registered in ClinicalTrials under the ID: NCT02829567 on 11 July 2016.

Participants

A total of 130 participants were randomly selected and recruited, among orthodontic patients wearing fixed appliances from our Orthodontic Department, from September 2016 to December 2017. Flowchart of the study is shown in Figure 1.

Parental written consent and patient's assent on their participation were obtained.

Inclusion criteria

Eligibility criteria for patients to participate in the study were Caucasian adolescents and adults aged 12–25 years, who were wearing fixed appliances in both arches, within the first

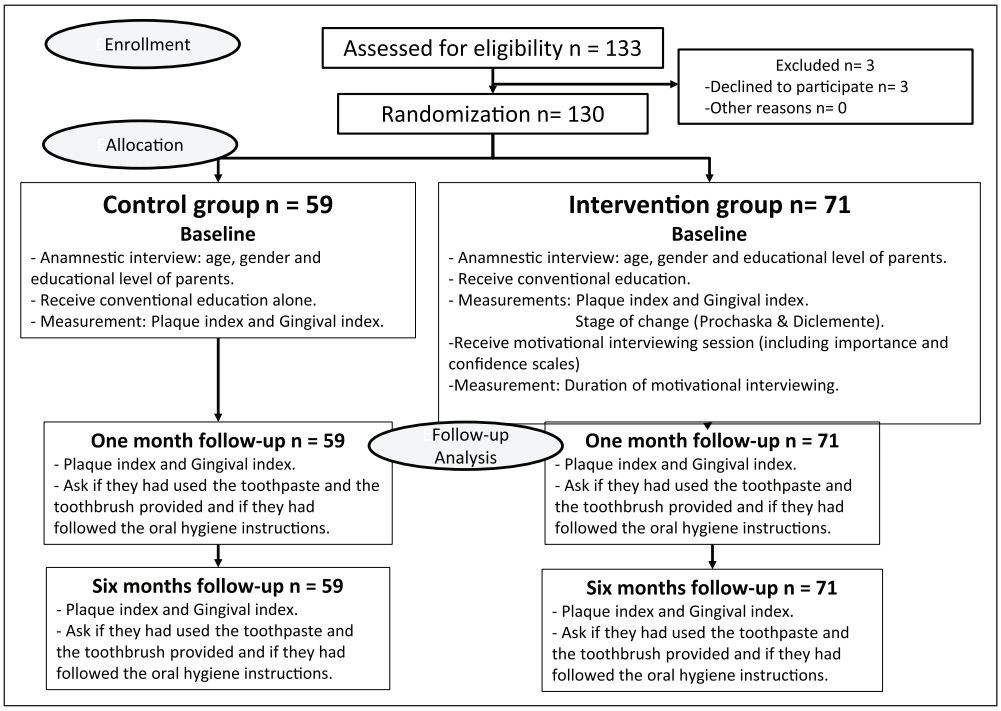

Figure 1. Study flow chart.

6 months of treatment. The eruption had to be completed (except for the third molars) or in the late mixed dentition.

Exclusion criteria

Patients were excluded from the study if they had any of the following characteristics: any periodontal disease prior to enrolment or during the study, any systemic disease such as diabetes, extensive dental restorations, dental fluorosis, pregnancy, smoking habit, antibiotic therapy or dental treatment affecting oral hygiene or gingival health; and the use of drugs influencing gingival hyperplasia or bleeding.

Benefits and risks

This study provided no additional risks to those involving orthodontic treatment. There was no financial benefit in participating in the study, that is, no fee or payment. All participants received orthodontic toothpaste and a toothbrush every 2 months during the study period.

Randomization

Each patient was allocated to the intervention group (IG) or control group (CG) according to the sequence of codes generated randomly by software. This sequence of codes was prepared by an independent researcher, who was unaware of the numeric codes for the CG or IG.

Characteristics according MI

As established by the MI founders Miller and Rollnick (2014), all the sessions accomplished the spirit of the MI: (1) collaboration—the interviewer sought to create a positive interpersonal atmosphere that was conducive to change but not coercive; (2) evocation—it assumed that people already had motivations and resources within themselves that could be called

on; (3) acceptance—it involved prizing the inherent worth and potential of every one, and (4) compassion—it actively promoted the other's welfare, and thus it gave priority to the other's needs.

The development of the session comprised four processes: (1) engaging—both parties established a helpful connection and a working relationship; (2) focusing—it is the process by which a specific direction in the conversation about change is developed and maintained; (3) evoking—it involves eliciting the client's own motivations for change and is the heart of MI, and (4) planning—it encompasses both developing commitment to change and formulating a specific plan of action.

The practice of MI also involved the flexible and strategic use of some core communication skills: asking open questions, affirming, reflective listening, and summarizing. These skills cut across the four processes described above and were needed throughout the MI.

As a part of the brief MI intervention, we adapted to oral hygiene the readiness ruler which assesses the importance of having a good oral hygiene and then subsequently eliciting change talk. Patients were asked: "*On a scale from 0–10, how important is it to you to have a good oral hygiene right now?*" When the patients responded with a number, the orthodontist followed up with an inquiry designed to evoke the person's own motivations to engage in the behavior change. Such an inquiry was intentionally framed so that people could respond with the reasons why the desired behavior was important and desirable to them.

In addition, to assess confidence in making the change, patients were asked: "*On a scale from 0–10, how confident are you in improving your oral hygiene?*"

Training in MI and fidelity assessment

The counselor was an orthodontist who attended a 2-year training in MI of 112 hours from October 2014 to September 2016. The training included both theoretical and practical sessions delivered by an accredited MI trainer. Learning started with two-level training workshops of 30 hours each and the second-level course was repeated. The workshops were followed by several sessions of coaching with feedback based on observed practice. The orthodontist only started the MI sessions when she was able to demonstrate satisfactory competence as it is evaluated by The Motivational Interviewing Treatment Integrity Scale (MITI; Moyers et al., 2007), after a learning curve under the supervision of the accredited MI trainer.

All the sessions were audiotaped, and 20 percent of them were coded using MITI 3.0 to assess the MI fidelity by an independent reviewer. The MITI 3.0 includes global scores on empathy, evocation, collaboration, autonomy/support, and direction, which are assessed on a scale from 1 (poor) to 5 (excellent). Competency in MI is defined using values above four points.

Characteristics according transtheoretical model stages of change

Stage of readiness to change was assessed at baseline in the IG before receiving the MI session as it is shown in Figure 2. Stage of change as derived from the transtheoretical model (Prochaska and Diclemente, 1992) and applied to oral hygiene behaviors was assessed by asking the participants to choose one out of five options: 1. *I don't think I should change my oral hygiene* (Pre-contemplation); 2. *I don't brush my teeth very well but I'd like to do it better* (Contemplation); 3. *I've planned to brush my teeth better or more time* (Preparation); 4. *I have good oral hygiene and I have started having it for the last 6 months* (Action); and 5. *I've always brushed my teeth properly, and I have been doing so for longer than 6 months* (Maintenance).

According to Prochaska and Diclemente, individuals being at the first stage of change are not thinking about improving their oral hygiene habits. During the second stage, contemplation, individuals think about having better oral hygiene. At the third stage, preparation, patients

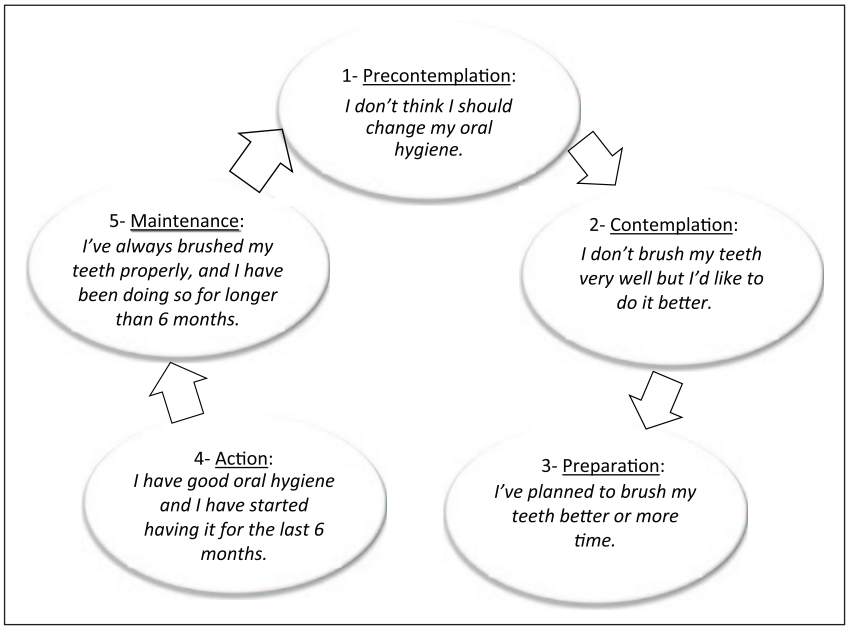

Figure 2. Stages of change applied to oral hygiene behaviors (Prochaska and Diclemente, 1992).

start engaging in some oral brushing, whereas at the action stage patients have been brushing more often, although it has happened for less than 6 months. Finally, the maintenance stage is characterized by sustained brushing habits for more than 6 months.

CG

In the CG, participants received a 15-minute oral health education talk delivered by the orthodontist. The talk covered the modified Bass brushing technique with a mouth model and pictures, patient brushing under supervision, and the importance of oral hygiene in order to prevent caries and periodontal diseases.

Patients were instructed to brush at least twice a day with the toothpaste and the orthodontic toothbrush provided, after every major meal, with a 3-minute average brushing time following the modified Bass technique. Participants were examined in a supine position, using a mouth mirror and a dental probe.

IG

This group received the same conventional education as the CG followed by a single session of MI delivered by the orthodontist. The characteristics of MI sessions, training, and codification have been previously described.

Variables recorded for all participants

At baseline, all participants were asked about their age, gender, and parental education level. At 1 and 6 months, the participants were asked if they had used the toothpaste and the toothbrush provided and if they had followed the oral hygiene instructions.

Main outcomes

We measured two indexes because plaque index serves as an indicator of plaque accumulation and gingival index serves as a long-term parameter for the status of the gingiva. The thickness of the soft deposit in the gingival area of the teeth surfaces was evaluated using the plaque

index Löe And Silness (Silness and Löe, 1964). In addition to that, qualitative changes in the gingival tissue were evaluated using the gingival index from the same authors (Löe and Silness, 1967). The orthodontist measured, in both groups, both indexes before the orthodontic treatment session, at baseline, at 1 month, and at 6 months as a follow-up. A dental mirror and a pocket probe were used and the teeth and gingiva were dried prior to the assessment, as described in the original article by the authors. The assessment of plaque index always preceded that of gingival index.

Plaque index and gingival index were used in four gingival areas (mesial, buccal, distal, and lingual) giving in each one a score from 0 to 3 and in six selected teeth (1.6, 2.1, 2.4, 3.6, 4.1, and 4.4) according to the Ramfjord system, in which each group of teeth (incisors, premolars, and molars) has its representative and is a useful alternative to full-mouth measurements (Mumghamba et al., 2004). Plaque and gingival indexes for each patient were obtained by calculating the mean value from all the examined surfaces.

The criteria for the plaque index system are as follows:

1. No plaque in the gingival area;
2. A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may only be recognized by running a probe across the tooth surface;
3. Moderate accumulation of soft deposits within the gingival pocket, on the gingival margin, and/or adjacent tooth surface, which can be easily seen by the naked eye;
4. Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface.

The criteria for the gingival index system are as follows:

1. Normal gingival;
2. Mild inflammation—slight change in color and slight edema. No bleeding on probing;
3. Moderate inflammation—redness, edema, and glazing. Bleeding on probing;
4. Severe inflammation—marked redness and edema. Ulceration. Tendency to spontaneous bleeding.

Subjects with mild inflammation usually score from 0.1 to 1, those with moderate inflammation score from 1.1 to 2.0, and an average score from 2.1 to 3.0 signifies severe inflammation.

Variables specific for the IG at baseline

Importance assessment, using the question: "On a scale from 0–10, how important is it to you to have a good oral hygiene right now?"

Confidence assessment, using the question: "On a scale from 0–10, how confident are you in improving your oral hygiene?"

Duration of MI session.

The stage of change according to Prochaska and Diclemente.

Sample size calculation

The determination of the sample size was based on previous estimates of plaque index variability (standard deviation (SD): 0.4) in adolescents undergoing orthodontic treatment by setting type I error at 0.05 and type II error at 0.20 (targeted statistical power of 80%). With these parameters, 30 participants for each group were needed to detect a decrease in the plaque index of about 30 percent in the IG (the plaque index was expected to decrease from 0.9 to 0.6 at 1 month).

Assuming the decrease in the plaque index in the CG and accounting for possible drop-outs during the follow-up, we therefore aimed to recruit a total of 130 patients.

Statistical analysis

Study participants were characterized using mean and standard deviation, median and per-

Table 1. Sociodemographic characteristics, overall and by group.

	Overall	Control group	Intervention group	*p*-value
N	130	59	71	
Sex (female), *n* (%)	81 (62.3)	40 (67.8)	41 (57.8)	0.239
Age (years), mean (SD)	14.5 (2.9)	15.0 (3.5)	14.1 (2.3)	0.087
Age (years), median (p25–p75)	13 (12–16)	14 (12–16)	13 (12–15)	0.457
Age, *n* (%)				
Between 12 and 18 years	118 (91)	50 (84.7)	68 (95.8)	0.031
19 or more years	12 (9)	9 (15.3)	3 (4.2)	
Parental studies, *n* (%)				
Primary education	26 (20.0)	12 (20.3)	14 (19.7)	0.951
Secondary education	35 (26.9)	16 (27.1)	19 (26.8)	
Professional education	4 (3.1)	1 (1.7)	3 (4.2)	
Superior education	63 (48.5)	29 (49.2)	34 (47.9)	
Don't know	2 (1.5)	1 (1.7)	1 (1.4)	

SD: standard deviation.

Table 2. Comparison of plaque and gingival indexes by group within visits.

	Baseline	1 month	6 months
Plaque index			
Control, mean (SD)	0.91 (0.49)	0.86 (0.44)	0.79 (0.37)
Intervention, mean (SD)	1.05 (0.46)	0.53 (0.30)	0.61 (0.29)
p-value	0.107	<0.001	0.002
Gingival index			
Control, mean (SD)	0.70 (0.44)	0.67 (0.42)	0.66 (0.39)
Intervention, mean (SD)	0.72 (0.36)	0.39 (0.27)	0.44 (0.28)
p-value	0.755	<0.001	<0.001

SD: standard deviation.
Two-sample *t*-test with equal variances is used to compare the mean between the two groups at each of the time points and for both of the indexes.

centiles 25, 75 or number of subjects, and percentages, depending on their nature.

To compare the plaque and gingival indexes among the different follow-up periods and within the two groups, we used the *t*-test statistic. Sensitivity analyses were done to stratify the main results by use of toothpaste, toothbrush, and following the oral hygiene instructions. All analyses were conducted using Stata 14.0 (StataCorp, College Station, TX, USA).

Results

Sociodemographic characteristics are shown in Table 1. In summary, mean (SD) age was 14.5 years (2.9), 81 were female (62%), and most of the parents (52%) had a high education level (professional formation or superior education). No differences in sociodemographic data were found between the two groups.

Results on the main outcomes are shown in Table 2. At baseline, we found no statistical differences in the plaque index, nor in the gingival index between both groups ($p=0.107$ and $p=0.755$, respectively). However, significant differences ($p<0.05$) were found when comparing the plaque and gingival indexes at 1 and 6 months; reduced values were found in the IG reflecting an improvement in oral hygiene.

Table 3. Within-group comparison of plaque and gingival indexes.

	Baseline	1 month	*p*-value	1 month	6 months	*p*-value	Baseline	6 months	*p*-value
Plaque index									
Control, mean (SD)	0.91 (0.49)	0.86 (0.44)	0.333	0.86 (0.44)	0.79 (0.37)	0.106	0.91 (0.49)	0.79 (0.37)	0.029
Intervention, mean (SD)	1.05 (0.46)	0.53 (0.30)	<0.001	0.53 (0.30)	0.61 (0.29)	0.046	1.05 (0.46)	0.61 (0.29)	<0.001
Gingival index									
Control, mean (SD)	0.70 (0.44)	0.67 (0.42)	0.606	0.67 (0.42)	0.66 (0.39)	0.778	0.70 (0.44)	0.66 (0.39)	0.471
Intervention, mean (SD)	0.72 (0.36)	0.39 (0.27)	<0.001	0.39 (0.27)	0.44 (0.28)	0.158	0.72 (0.36)	0.44 (0.28)	<0.001

SD: standard deviation.
Two-sample *t*-test with equal variances is used to compare mean values of baseline and 1-month follow-up, 1-month and 6-month follow-ups, and baseline and 6-month follow-up, for each intervention group and for both indexes.

Table 4. Results specific for the intervention group.

Importance scale, mean (SD)	8.8 (1.2)
Confidence scale, mean (SD)	8.1 (1.3)
Motivational interviewing duration, *n* (%)	
Up to 10 minutes	32 (45.1)
Between 10 and 20 minutes	35 (49.3)
Between 20 and 30 minutes	4 (5.6)
Stage of change, *n* (%)	
Contemplation	18 (25.4)
Preparation for action	31 (43.7)
Action	16 (22.5)
Maintenance	6 (8.4)

SD: standard deviation.

In Table 3, we present the paired *t*-test comparison between the different visits (baseline vs 1 month, 1 month vs 6 months, and baseline vs 6 months) regarding plaque and gingival indexes within groups. An improvement of the oral hygiene was shown, with a plaque and gingival index reduction in the IG when comparing baseline with 1-month follow-up (1.05 (0.46) vs 0.53 (0.30) and 0.72 (0.36) vs 0.39 (0.27), respectively; $p < 0.001$ for both comparisons). At 6 months, this improvement remained stable for plaque and gingival indexes when compared to 1-month follow-up (0.53 (0.30) vs 0.61 (0.29); $p = 0.046$ and 0.39 (0.27) vs 0.44 (0.28); $p = 0.158$, respectively). When comparing baseline to the 6-month period, an improvement was found in the IG regarding plaque and gingival indexes (1.05 (0.46) vs 0.61 (0.29) and 0.72 (0.36) vs 0.44 (0.28), respectively; $p < 0.001$ for both comparisons). In the CG, statistical differences were also found for the plaque index (0.91 (0.49) vs 0.79 (0.37); $p = 0.029$).

In Table 4, specific results for the IG are summarized. The mean value of the importance scale was 8.8 (1.2), whereas for the confidence scale it was 8.1 (1.3). A total of 32 MI sessions lasted up to 10 minutes (45.1%), while most of them, that is, 35, lasted between 10 and 20 minutes (49.3%) and only 4 of them (5.6%) lasted between 20 and 30 minutes. Regarding the transtheoretical model, 18 participants reported to be at the contemplation stage (25.4%), 31

(43.7%) at the preparation stage, 16 were at the action stage (22.5%), and 6 at the maintenance one (8.4%). None of them was identified with the precontemplation stage.

Most of the participants (84%) used the provided toothpaste during all the study period, 85 percent used the provided toothbrush, and 98 percent reported to have followed the oral hygiene instructions during all the period. After stratifying by use of toothpaste or toothbrush, the results were kept (results not provided).

Discussion

This study revealed an immediate positive effect of a single session of MI combined with conventional education, which resulted in a strong decrease of plaque and gingival indexes at a 1-month follow-up, compared with only delivering information and instructions about oral hygiene. This improvement remained stable throughout the 6-month period of the study showing that, after a session of MI in combination with conventional education, oral hygiene improved both in a punctual and continuous way. Conventional education alone was also found to be effective but it only decreased the plaque index in the long-term when compared to baseline. Less influence has been found regarding conventional education alone and the decrease in the gingival index. Therefore, the combination with a session of MI is needed to strengthen the oral hygiene.

The success of our results can be due to several reasons. First of all, the orthodontic population studied referred a high motivational level at baseline due to different aspects: they were performing an orthodontic treatment focused on improving their oral health (for both functional and esthetic reasons), and the importance and confidence scales in oral hygiene were both very high at baseline, with mean scores above 8. Moreover, according to the results from the transtheoretical model, more than 70 percent of the participants reported to be in more advanced stages of change (preparation, action, or maintenance). It is also worth pointing out that our participants were adolescents and young adults, a kind of population that is a priori resistant to direct advice. That is why MI also resulted very useful to them.

Second, regarding the background of the counselor, the clinician who delivered the MI session was an orthodontist trained in MI skills and was the same counselor for all the participants, which made the method, the principles, and the style of MI be always the same. Besides, the knowledge and experience in dental hygiene and oral health could be relevant for an MI dental counselor to accomplish good results. Likewise, it seems remarkable that the engagement with patients is established from the beginning, with a helpful connection and a good working relationship. In contrast to other studies, the background differs from ours: a psychologist in the study by Stenman et al. (2012, 2017), dental hygienists (Jönsson et al., 2009b, 2010), or dental students (Woelber et al., 2016).

The third is the significant investment in time training of the counselor (above 112 hours in 2 years, by far higher than the 8 and 12 hours duration of the training in the study by Woelber et al., 2016), and prior to the beginning of the study it is relevant to obtain optimal skills to apply the MI principles in its full potential. As Miller and Rollnick (2014) stated, learning MI is a continuous and lengthy process.

The major strength of our study was the high quality of MI, which was revealed by MITI 3.0 average values ranging from 4 to 4.5 coded by an independent researcher. Studies made by Woelber used MITI 2.0 to analyze the quality, but it is important to emphasize that rating scales for MITI 3.0 and MITI 2.0 are not comparable. The fact that the brief session of MI was not combined with any other behavioral intervention, like in studies conducted by Jönsson et al. (2009a, 2009b, 2010), heightens its quality. Moreover, with a short investment of time in the same orthodontic appointment (between 10 and 20 minutes), very satisfactory results were achieved with long-term beneficial effects, thus making it possible to implement this kind of interventions in the daily routine of an orthodontic practice. What is more,

we minimized the use of any plaque-reducing components, or any other product that could generate bias to the results, by providing the same orthodontic toothpaste and toothbrush every 2 months to all participants.

To our knowledge, this study is the first attempt to introduce a single session of MI in orthodontic population and to identify the stage of change in it. Lalic et al. (2012) studied the effect of counseling on orthodontic patients, but they did not report if they used the style of MI according to Miller and Rollnick. In addition, neither the appropriate training of counselors nor the assessment of the MI fidelity by an independent reviewer was mentioned. This lack of standardization can be the reason why they did not find any difference in plaque reduction between groups.

A recent study by Kamalikhah et al. (2017) classified dental flossing behavior among students using the transtheoretical model, and found that nearly half of them were in the precontemplation stage. These differences can be explained because the population studied had different social and cultural backgrounds.

In a systematic review of the literature, Gao et al. (2014) and Kopp et al. (2017) showed contradictory effects of MI on improving periodontal health, on preventing early childhood caries, and on changing other oral health behavior (Albino and Tiwari, 2016; Gauba et al., 2016). The discrepancies between studies could be explained because of confusing methodological quality. Some authors do not provide details on specific component that should be useful to define MI as frequency, duration, and fidelity.

We can point out that training dental hygienists as part of the working team to become experts in MI focused on dental settings could be useful, in order to empower the motivation of orthodontic patients.

The fact that the assessment of main outcomes (the plaque index and the gingival index) was done by the same orthodontist who delivered the MI session in both groups represents the main limitation of this study. Nevertheless, we should be aware that both indexes are objective measures that are not influenced by the observer. Although this approach was made trying to reproduce an everyday orthodontic appointment, it would be necessary to generalize the results in the private practice. We are also aware that the Hawthorne effect (patient awareness of being examined and evaluated) could be present in the study, but it may not have influenced the results because the CG maintained the oral hygiene at similar baseline levels.

Conclusion

A short time-consuming session of MI combined with conventional education is useful to improve oral hygiene, since it decreases plaque and gingival indexes, in adolescents and young adults wearing fixed appliances. This improvement remains stable after a 6-month follow-up.

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References

Acharaya S, Goyal A, Ultreja AK, et al. (2011) Effect of three different motivational techniques on oral hygiene and gingival health of patients

undergoing multibracketed orthodontics. *The Angle Orthodontist* 81(5): 884–888.

Albino J and Tiwari T (2016) Preventing childhood caries: A review of recent behavioral research. *Journal of Dental Research* 95(1): 35–42.

Armitage C and Arden M (2007) Felt and potential ambivalence across the stages of change. *Journal of Health Psychology* 12(1): 149–158.

Arnold S, Koletsi D, Patcas R, et al. (2016) The effect of bracket ligation on the periodontal status of adolescents undergoing orthodontic treatment. A systematic review and meta-analysis. *Journal of Dentistry* 54: 13–24.

Brand VS, Bray KK, MacNeill S, et al. (2013) Impact of single-session motivational interviewing on clinical outcomes following periodontal maintenance therapy. *International Journal of Dental Hygiene* 11(2): 134–141.

Croffoot C, Bray KK, Black MA, et al. (2010) Evaluating the effects of coaching to improve motivational interviewing skills of dental hygiene students. *Journal of Dental Hygiene* 84(2): 57–64.

Curtin S, Trace A, Ziada H, et al. (2014) Motivational interviewing for dental clinicians. *Journal of the Irish Dental Association* 60(1): 35–37.

Freudenthal JJ and Bowen DM (2010) Motivational interviewing to decrease parental risk-related behaviors for early childhood caries. *Journal of Dental Hygiene* 84(1): 29–34.

Gao X, Lo EC, Kot SC, et al. (2014) Motivational interviewing in improving oral health: A systematic review of randomized controlled trials. *Journal of Periodontology* 85(3): 426–437.

Gao X, Lo EC, McGrath C, et al. (2013) Innovative interventions to promote positive dental health behaviors and prevent dental caries in preschool children: Study protocol for a randomized controlled trial. *Trials* 14: 118.

Gauba K, Goyal A and Mittal N (2016) A CAMBRA model for high risk Indian children: A pragmatic comprehensive tailored intervention. *Journal of Clinical Pediatric Dentistry* 40(1): 36–43.

Harrison R (2014) Motivational interviewing (MI) compared to conventional education (CE) has potential to improving oral health behaviors. *The Journal of Evidence-Based Dental Practice* 14(3): 124–126.

Ismail AI, Ondersma S, Jedele JMW, et al. (2011) Evaluation of a brief tailored motivational intervention to prevent early childhood caries. *Community Dentistry and Oral Epidemiology* 39(5): 433–448.

Jönsson B, Ohrn K, Lindbert P, et al. (2010) Evaluation of an individually tailored oral health educational programme on periodontal health. *Journal of Clinical Periodontology* 37(10): 912–919.

Jönsson B, Ohrn K, Oscarson N, et al. (2009a) An individually tailored treatment programme for improved oral hygiene: Introduction of a new course of action in health education for patients with periodontitis. *International Journal of Dental Hygiene* 7(3): 166–175.

Jönsson B, Ohrn K, Oscarson N, et al. (2009b) 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). *Journal of Clinical Periodontology* 36(12): 1025–1034.

Kamalikhah T, Mazllomi Mahmood Abad S, Khalighinejad N, et al. (2017) Dental flossing behaviour and its determinants among students in a suburb area of Tehran-Iran: Using transtheoretical model. *International Journal of Dental Hygiene* 15(2): 106–112.

Kopp S, Ramseier C, Ratka-Krüger P, et al. (2017) Motivational interviewing as an adjunct to periodontal therapy—A systematic review. *Frontiers in Psychology* 8: 279.

Lalic M, Aleksic E and Gajic M (2012) Does oral health counseling effectively improve oral hygiene of orthodontic patients? *European Journal of Paediatric Dentistry* 13(3): 181–186.

Löe H and Silness J (1967) The gingival index, the plaque index and the retention index systems. *Journal of Periodontology* 38: 610–616.

Martins RK and McNeil DW (2009) Review of motivational interviewing in promoting health behaviors. *Clinical Psychology Review* 29(4): 283–293.

Miller WR and Rollnick S (2009) Ten things that motivational interviewing is not. *Behavioural and Cognitive Psychotherapy* 37(2): 129–140.

Miller WR and Rollnick S (2014) The effectiveness and ineffectiveness of complex behavioral interventions: Impact of treatment fidelity. *Contemporary Clinical Trials* 37(2): 234–241.

Mitchell SH, Overman P and Forrest JL (2014) Critical thinking in patient centered care. *The Journal of Evidence-Based Dental Practice*.14: 235–239.

Moyers TB, Martin T, Manuel JK, et al. (2005) Assessing competence in the use of motivational interviewing. *Journal of Substance Abuse Treatment* 28(1): 19–26.

Moyers TB, Martin T, Manuel JK, et al. (2007) Revised global scales: Motivational interviewing treatment integrity 3.0 (MITI 3.0). Available at: http://casaa.unm.edu/codinginst.html

Mumghamba EGS, Pitiphat W, Matee MIN, et al. (2004) The usefulness of using Ramfjord teeth in predicting periodontal status of a Tanzanian adult population. *Journal of Clinical Periodontology* 31(1): 16–18.

Neff J, Walters S, Braitman A, et al. (2013) A brief motivational intervention for heavy alcohol use in dental practice settings: Rationale and development. *Journal of Health Psychology* 18(4): 542–553.

Prochaska JO and DiClemente CC (1984) *The Transtheoretical Approach: Crossing Traditional Boundaries of Therapy*. Homewood, IL: Dow Jones-Irwin.

Prochaska JO, DiClemente CC and Norcross JC (1992) In search of how people change. Applications to addictive behaviors. *American Psychologist* 47(9): 1102–1114.

Silness J and Löe H (1964) Periodontal disease in pregnancy II. Correlation between oral hygiene and periodontal condition. *Acta Odontologica Scandinavica* 22: 112–135.

Stenman J, Lundgren J, Wennström JL, et al. (2012) A single session of motivational interviewing as an additive means to improve adherence in periodontal infection control: A randomized controlled trial. *Journal of Clinical Periodontology* 39(10): 947–954.

Stenman J, Wennström JL and Abrahamsson KH (2017) A brief motivational interviewing as an adjunct to periodontal therapy—A potential tool to reduce relapse in oral hygiene behaviours. A three-year study. *International Journal of Dental Hygiene*. Epub ahead of print 24 August. DOI: 10.1111/idh.12308.

Woelber JP, Spann-Aloge N, Hanna G, et al. (2016) Training of dental professionals in motivational interviewing can heighten interdental cleaning self-efficacy in periodontal patients. *Frontiers in Psychology* 7: 254.